Series 1960, No. 16

Issued January 1964

Soil Survey
HOOKER COUNTY NEBRASKA

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF NEBRASKA
Conservation and Survey Division

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Hooker County will help ranchers in protecting their grasslands and keeping them productive; show relative value of soils for cultivated crops; assist engineers in selecting sites for roads and other structures; guide those who want to plant windbreaks to protect fields and farmsteads; and serve as a reference for students, teachers, and others interested in the soils and agriculture of the county.

Locating soils

Use the index to map sheets at the back of this report to find areas on the soil map. This index shows the location of each numbered sheet of the large soil map. On this large soil map, it will be seen that all areas of a given kind of soil are identified by a map symbol.

Finding information

This soil survey report is arranged to serve different major groups of readers. The introductory pages and the section "How Soils Are Named and Mapped" serve mainly those readers who are not familiar with the county or with the methods soil scientists use in surveying and classifying soils.

Ranchers and those who work with them can learn about the soils in the section "Descriptions of the Soils," and then turn to the section "Managing Rangeland," where the soils that support similar vegetation and need similar management have been placed in groups called range sites. In that section is information on the principal plants on each range site and on estimated yield of herbage in favorable and unfavorable years.

Information on use of the soils for cultivated crops is given in the section "Capability Groups of Soils," where soils similar in needed management and in response to that management have been placed in groups called capability units.

Those interested in protecting their fields and homesites from wind will want to read the section "Management of Woodland and Shelterbelts."

The "Guide to Mapping Units, Range Sites, and Capability Units" at the back of the report will simplify use of the map and the report. This guide gives the name and map symbol for each soil, and the page on which the soil is described; and in addition, the range site and capability unit in which the soil has been placed, and the page where each of these is described.

Engineers and builders will find information that will assist them in the section "Interpreting Soil Properties for Engineering."

Soil scientists and others interested in how the soils were formed will want to read the section "Origin and Classification of Soils."

* * * *

This soil survey was made cooperatively by the Soil Conservation Service and the Conservation and Survey Division of the University of Nebraska. It is part of the technical assistance furnished to the Grant-Hooker Soil and Water Conservation District, which ranchers organized in 1950. Fieldwork for this survey was completed in 1960. Unless otherwise indicated, all statements in the report refer to conditions in that county at that time.

Cover picture

Rangeland along the Middle Loup River. Soils of the Subirrigated and the Wet Land range sites are near the river, and soils of the Thin Breaks range site in the background.

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Contents

Series 1960, No. 16 Issued January 1964

SOIL SURVEY OF HOOKER COUNTY, NEBRASKA

BY MERRITT A. PLANTZ AND DANIEL L. MERKEL, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

HOOKER COUNTY is near the center of the Sandhills region in Nebraska (fig. 1). It is an area of sandy soils almost entirely covered by native grasses. Raising of beef cattle is the main enterprise. Only small areas are cultivated, and these mainly to grow winter feed for cattle that graze the rangeland. The total area of the county is approximately 461,000 acres, and less than 2,000 acres of this is now cultivated.

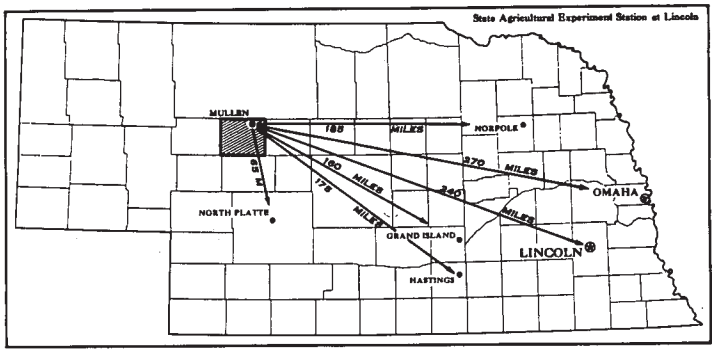


Figure 1.—**Location of Hooker County in Nebraska.**

In 1874, or thereabout, cattlemen who had ranches in the Platte Valley to the south began to use the area now within Hooker County as summer range. About 10 years later, homesteaders began to arrive. In spite of opposition from the cattlemen, who were grazing Government land, the number of homesteaders increased.

In 1887, about 3 years after homesteading began, the Chicago, Burlington, and Quincy Railroad Company extended a line through the territory, mainly to serve the cattlemen, but also to encourage homesteading. In 1889, the county was organized and named for Joseph Hooker, a general in the Civil War. The same year, a courthouse was built at Mullen, the present county seat. Mullen was at first a depot on the line built by the Chicago, Burlington, and Quincy Railroad.

Hooker County was among the last settled in Nebraska, and for this reason some of the mistakes made by earlier settlers were avoided. Nevertheless, many of the homesteaders were from the East. They had a few cattle and plowed the sandy soils to grow corn and other grains for their hogs and chickens. Eventually, a maximum of about 25,000 acres was brought under cultivation. But the good yields obtained shortly after breaking the sandy soils soon declined, and this, combined with wind erosion and the severe drought of the 1930's, brought about conversion of most of the cultivated land back to grass.

The main resources of the county, grass and water, are now utilized effectively in producing beef. Good distribution of water allows efficient use of the range. Underground water of good quality is abundant, and the Middle Loup and Dismal Rivers flow in this county.

Ranches in this county are large, and for the most part, are owned by the operators. A few ranches or areas of grazing land are leased from owners who have retired and moved into town. Headquarters for several large ranches are located in adjoining counties. Data on number of farms and ranches, land use, and numbers of livestock are shown in table 1.

TABLE 1.—*Number of farms and ranches, land use, and numbers of livestock in stated years* [1]

Year	Farms and ranches	Cropland harvested	Land irrigated	Cattle	Milk cows	Horses and mules	Swine	Sheep	Chickens
	Number [2]	*Acres*	*Acres*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
1931	157	16, 810	0	12, 420	950	1, 830	2, 550	670	9, 800
1938	147	8, 010	0	13, 160	1, 100	1, 460	670	370	6, 100
1945	100	3, 895	0	12, 060	660	1, 280	1, 630	370	7, 260
1954	80	1, 350	360	18, 070	320	490	220	0	4, 160
1960	60	810	440	18, 530	190	(3)	170	10	1, 300

[1] Figures from Nebraska Agricultural Statistics.

[2] Unpublished estimates from State-Federal Division of Agricultural Statistics.

[3] No data available.

The total population of the county was 1,130 in 1960. In that year, the population of Mullen, the largest town, was 811.

The county is served by churches of several denominations. The entire county is organized into a single school district. A grade school and a high school are located in Mullen. Four moveable schoolhouses serve grade-school pupils in rural areas. These four school houses are moved from place to place according to changes in number and location of pupils of grade-school age.

Good fishing and hunting are available. Social and service clubs are active. School and community athletic events and rodeos are well attended.

The county is served by the Chicago, Burlington, and Quincy Railroad. Hard-surface State Highway No. 2 crosses the northern part of the county. State Highway No. 97 runs south from Mullen to North Platte. Parts of the county are served by one-lane blacktop roads, but many ranchers have to travel several miles of sandhill trails to reach an improved road.

How Soils Are Named and Mapped

Soil scientists made this survey to learn what kinds of soils are in Hooker County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils and vegetation. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Anselmo and Valentine, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Valentine fine sand and Valentine loamy sand are two soil types in the Valentine series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Valentine fine sand, rolling, is one of several possible phases of Valentine fine sand, a soil type that ranges from rolling to hilly.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because these show native grasslands, buildings, field borders, and similar detail that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately associated, and so small in size, that it is not practical to show them separately on the map. He shows this pattern of soils as one mapping unit and calls it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Dunday-Anselmo. Also, there are areas that are so shallow or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Blown-out land, and are called land types rather than soils.

Only part of a soil survey is done when a soil scientist has named and described the soil series and mapping units, and has shown the location of the mapping units on the soil map. The mass of detailed information he has recorded then needs to be presented in different ways for different groups of users, among them farmers, managers of rangeland, and engineers.

To do this efficiently, he prepares different groupings of soils for the various major uses. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing the short-lived crops and tame pasture; range sites, for those using large tracts of native grass; windbreak groups for those who can benefit from the protection these provide; and the classifications engineers use in designing and building highways or structures to conserve soil and water.

In deriving groupings, the scientist first applies his knowledge of the characteristics and qualities of the soils to prepare trial groupings. He tests and adjusts these trial groupings by studying records on soil performance, by observing growing crops or existing structures, and by consulting with farmers, agronomists, engineers, and others who work with the soils. Thus, the groupings he finally presents reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

After studying the soils in a locality and the way they are arranged, a soil scientist can make a general map that shows the main patterns of soils, which are called soil associations. Such a map is the colored map in the back of this report. Each association, as a rule, contains a few major soils and several minor soils in a pattern that is characteristic, though not strictly uniform.

The soils within any one association are likely to differ greatly from one another in many properties; for example, in slope, depth, thickness of surface soil, or natural drainage. Thus, the general soil map does not show the kind of soil at any particular place, but patterns of soils. In each of these patterns, or associations, there are several different kinds of soil.

A soil association is named for the major soil series in it, but as already noted, soils of other series may also be present. The major soils of one association may also be present in another association, but in a different pattern and proportion.

A general soil map showing patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming, ranching, or other land use. The six soil associations in Hooker County are described in the following pages. Readers who want more information about the soil series mentioned in these associations can refer to the section "Descriptions of the Soils."

1. Valentine, Rolling-Anselmo Soil Association: Rolling Hills and Valleys

This soil association is dominantly an area of low dunes and nearly level intervening valleys or swales in the eastern part of the county. A few of the dunes, however, are more than 100 feet high.

The soils are deep, well-drained eolian sands. Most of them show the influence of some silt blown from the Ogallala formation.

Valentine fine sand, rolling, makes up approximately 80 percent of this association. It is on the lower and smoother dunes. Its texture is mostly fine sand, but on the north-facing slopes adjacent to the valleys the texture is loamy fine sand in many places. About 10 percent of the acreage of this Valentine soil has been severely eroded.

Dunday and Anselmo soils, which account for most of the cultivated acreage, are in the nearly level valleys. They have a fine sandy loam to loamy fine sand surface soil and varying amounts of silt throughout their profile. About half the acreage of these soils has been moderately eroded by wind.

Valentine fine sand, hilly, is on the higher and steeper dunes and makes up about 10 percent of the association. This very young soil has less than 3 inches of poorly defined surface soil.

This soil association makes up about 15 percent of the total area of the county but contains approximately half of the cultivated land in the county. Ranch units are smaller than average on this association because it contains a higher proportion of cultivated land than the other soil associations.

2. Valentine, Hilly-Dunday Soil Association: Choppy Hills and Valleys

This soil association, in the southern and western parts of the county, is an area of choppy hills and intervening valleys. Many of the dunes are larger than those of soil association 1.

Valentine fine sand, rolling, is on the smoother dunes and covers about 50 percent of the total acreage. The Dunday and Anselmo soils, in the nearly level valleys and swales, make up about 10 percent of the total area. Valentine fine sand, hilly, is on the steeper and larger dunes, some of which reach a height of more than 300 feet. This hilly Valentine soil occupies about 40 percent of the association.

Little of this association is now cultivated. Most of the land once cultivated has been returned to range. Most of the ranches in this association are large.

3. Valentine, Hilly, Soil Association: Choppy Hills

This soil association occurs in a strip about 6 miles wide on both sides of the Dismal River. It does not include the narrow strip of breaks along the river. These breaks are in soil association 6.

The topography is rough. Dunes are high and steep, and for the most part, only swales intervene between the dunes. There are few valleys.

Valentine fine sand, hilly, makes up about 50 percent of this association, the highest proportion of this hilly soil in any of the six soil associations. The rest of the association is mostly Valentine fine sand, rolling. A few areas of Dunday soils are included in the swales.

All of this association is used as rangeland. It is so rough that few ranch headquarters or roads are located on it.

4. Valentine, Rolling, Soil Association: Rolling Hills

This soil association is along the northern edge of the county in an area consisting mostly of small and large dunes and a very few broad valleys. The dunes are smoother than those in soil association 3.

Valentine fine sand, rolling, on the smoother dunes, makes up approximately 70 percent of the association. Valentine fine sand, hilly, on the steeper and higher dunes, accounts for between 25 and 30 percent. Dunday soils occur in some small valleys and swales, and there are a few areas of poorly drained Loup soil along the south branch of the Middle Loup River, in the northwestern corner of the county.

The soils of this association are used mostly as rangeland.

5. Elsmere-Dunday-Valentine Soil Association: Hills and Wet Valleys

Several areas of this soil association occur along the western edge of the county. Broad, nearly level, poorly drained valleys are separated by ridged dunes. Some small lakes and marshes occur in this association, which is

an eastward extension of a generally poorly drained area in Grant County.

About 60 percent of the association is Valentine soils. Valentine fine sand, rolling, on the smoother dunes, makes up about 40 percent of the association, and Valentine fine sand, hilly, on the steeper and higher dunes, about 20 percent.

The well-drained soils of the valleys, the Dunday, have very little silt in their profile. They make up about 20 percent of the association. The imperfectly drained Elsmere soils account for about 15 percent, and the poorly drained Gannett soil about 5 percent. The Gannett soil occurs mainly in beds of several lakes and marshes that have been partially drained. All the soils of the valleys show little evidence of silty material blown from the Ogallala formation.

This soil association contains most of the high-producing wet hayland, which is mainly on Gannett and Elsmere soils. The other soils are used for range. None of the association is cultivated.

6. Valentine-Loup Soil Association: River Breaks and Bottoms

This association occurs in a narrow band on the breaks, or steep slopes, along the Middle Loup and Dismal Rivers. The rivers have cut through and exposed the Ogallala formation, and this Tertiary material has been mixed with the eolian sands. This mixed material is less permeable than the eolian sands. The less permeable material and steep slopes have helped produce the only defined drainage pattern in the county.

Valentine fine sand, rolling, occurs on the smoother slopes and makes up about 35 percent of the association. The texture of this soil, as it occurs in this association, is mostly loamy fine sand. Valentine fine sand, hilly, is on the steep slopes, those with a gradient of 50 to 80 percent. It makes up about 35 percent of the association. Rough broken land, on slopes of 60 to 100 percent, contains outcrops of the Ogallala formation. It accounts for about 25 percent of the association. The rest of the acreage is Elsmere and Loup soils along the streams.

Soils of this association are used mainly as range. The deeply dissected topography and scattering of native trees provide excellent winter protection for livestock.

Use and Management of Soils

This section deals with use and management of the soils in Hooker County for native range, for cultivated crops, for windbreaks, for wildlife, and for engineering. It explains the practices of management appropriate for rangeland and describes the range sites in the county. Also, it explains the capability grouping used to classify soils for production of cultivated crops, and provides estimated yields for the soils that are cultivated.

Managing Rangeland [1]

Native grass, growing on more than 99 percent of the land, is Hooker County's most important crop. According to the 1960 Census of Agriculture, about 1,926 acres, or 0.4 percent of the agricultural land, was in farm crops. Hay was harvested from about 60 percent of this farmed land. Native hay was harvested from about 7 percent of the rangeland. Thus, about 92 percent of the land was used exclusively as range.

The income from livestock products amounted to nearly 99 percent of all agricultural products sold in 1959. Cattle and calves represented about 99.5 percent of the livestock income.

Proper management of grazing is the most important practice for the conservation of soil, water, and plants. These three support the livestock, the source of almost all agricultural income.

The purpose of this section is to aid ranchers in planning the management of their ranges. It describes the range sites in the county, explains how range condition classes are appraised, provides estimated yields for range sites, and discusses practices that will improve yields from rangelands and native meadows.

Range sites

The rancher can best manage his soil and plant resources, for sustained high production, if he knows the soils and vegetation on his holdings. Soils differ in observable characteristics that are related to their ability to produce different kinds and amounts of native plants.

Range soils that produce essentially the same kinds or amounts of climax vegetation are grouped into categories termed "range sites." Each range site has its own combination of environmental conditions related to moisture, nutrients, and light. This special environment ultimately can produce a characteristic plant community, termed "climax vegetation for the site."

Climax vegetation, representing the highest point of plant succession, is a relatively stable plant community, compared to the weedy cover on old fields. It reproduces itself and changes little as long as climate and soil remain unchanged. It is the most productive combination of forage plants on rangelands, and a combination that will persist without tillage, fertilization, and replanting. Climax vegetation thus represents the potential in kind and amount of vegetation for a range site.

Surveys showing range sites and condition classes on a ranch give the operator an inventory of both present and potential grazing resources. They show areas of range that are producing below their potential and that could be improved. They also show areas that are producing at their potential. Thus, by using surveys of range sites and condition classes, the rancher can plan a grazing program to improve or maintain his range.

Six kinds of range sites are recognized in Hooker County. Two of these are on lowlands, and four are on uplands. Burzlaff (*4*),[2] following research on three upland sites in many sandhill counties of Nebraska, reported that prairie sandreed (*Calamovilfa longifolia*) ". . . stood out as the most uniformly distributed and most abundant species . . . ." He also found that the silt-clay fraction of the sand soils correlated with differences in the vegetation when ranges in excellent condition were compared.

The soils in each of the six sites in the county, the dominant forage plants in the climax vegetation of these sites,

[1] By LORENZ F. BREDEMEIR, range conservationist, Soil Conservation Service.

[2] Italic numbers in parentheses refer to Literature Cited, p. 38.

and percentages of total herbage each of these species may contribute are shown in table 2.

TABLE 2.—*Range sites of Hooker County, dominant plants in the climax vegetation, and the range in herbage production for each plant*

Range site and soils	Species dominant in climax vegetation	Range in proportion of total herbage on site
		Percent
Wet Land range site:		
Gannett sandy loam.	Tall sedges	25–80
Loup fine sand.	Prairie cordgrass	20–75
	Reedgrasses	0–40
Subirrigated range site:		
Loup loam.	Big bluestem	25–80
Elsmere fine sand.	Switchgrass	20–75
Elsmere loamy fine sand.	Indiangrass	15–65
Sandy range site:		
Anselmo loamy fine sand, 0 to 1 percent slopes.	Switchgrass	25–70
Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes.	Prairie sandreed	20–50
Dunday loamy fine sand, 2 to 5 percent slopes.	Sand bluestem	15–50
Dunday loamy fine sand, 2 to 5 percent slopes, eroded.		
Dunday loamy fine sand, terrace, 2 to 5 percent slopes.		
Sands range site:		
Valentine loamy sand, hummocky, eroded.	Prairie sandreed	20–50
	Little bluestem	15–40
Valentine fine sand, rolling.	Sand bluestem	10–35
	Switchgrass	5–30
Choppy Sands range site:		
Valentine fine sand, hilly.	Little bluestem	20–60
	Prairie sandreed	15–40
	Sand bluestem	10–40
	Sand lovegrass	5–25
Thin Breaks range site:		
Valentine soils and rough broken land.	Little bluestem	10–50
	Prairie sandreed	5–50
	Western wheatgrass.	5–40
	Sand bluestem	5–30
	Side-oats grama	5–20

Range condition

Range condition is the present state of the vegetation, as compared to climax vegetation for the type of land (range site). It is expressed as a percentage, which shows how much of the present vegetation is of the same kind as that in the climax vegetation.

The deterioration or improvement of range condition is gradual. In the course of such changes the same area of land is successively occupied by many kinds of plants in many combinations.

The ranch operator should know the major kinds of range plants that should be growing on different sites. He needs to know how these plants respond to differences in grazing, and he especially needs to know appropriate time and intensity of use. He needs to know the condition of his range and whether it is deteriorating or improving.

All the food plants use for growth is manufactured in their leaves. Removal of leaves during the manufacturing period affects growth of both roots and shoots. Livestock graze selectively; they remove more leaves from some plants than from others. Their selection of plants for grazing varies with season and the degree of range use. For this reason, pastures respond to grazing in different ways. Some kinds of plants decrease, some increase, and others originally not present may invade. These responses to grazing are used in a system for classifying range condition.

Decreaser species for a site are those present in the original plant community that decrease in amount of total herbage they contribute if they are continuously closely grazed during the growing season. *Increaser* plants are those of the original plant community that normally increase, at least for a time, in relative amount of total herbage they produce. They increase as the decreaser plants cover less of the site. *Invader* plants are those not in the original plant community that begin growing in an area after the decreasers and increasers have been weakened or eliminated.

Range condition of an area is determined by comparing its present vegetation with the original, or climax, vegetation for the site. Four condition classes (*6*, *7*,) are used to indicate this departure from the potential, or climax (fig. 2). Comparison of vegetation along fence lines will be helpful in determining range condition (fig. 3).

The goal of range management is range in the excellent or good range-condition class. Greatest yields are obtained, on a sustained basis, if range is in excellent condition. Also, soil and water losses are reduced to the minimum possible without artificial aids, and maximum use is made of rainfall and snowmelt.

Description of range sites

Following are brief descriptions of the six range sites recognized in Hooker County. Names of the soils included in each range site are given, along with other distinctive features.

WET LAND RANGE SITE

This range site occurs at the next higher elevation above marshes or open water, both along the major streams and in the enclosed Sandhill valleys (fig. 4, *A*). The soils are very dark and high in organic-matter content in the upper part of the profile.

The soils of this site are—

Gannett sandy loam.
Loup fine sand.

The plant cover on this range site is dominantly tall sedges and prairie cordgrass, with reedgrasses in some places. The site is too wet for big bluestem, Indiangrass, and switchgrass. Water is on the surface during the forepart of the growing season. As the vegetation grows and transpiration of moisture increases, the water table is lowered to a depth of 6 to 24 inches, depending on site characteristics and precipitation.

This site is used mainly for hay, as it often is too wet for grazing early in summer. Early grazing can seriously damage the land by causing hummocks. After the hay has been cut, the grass is allowed to make considerable

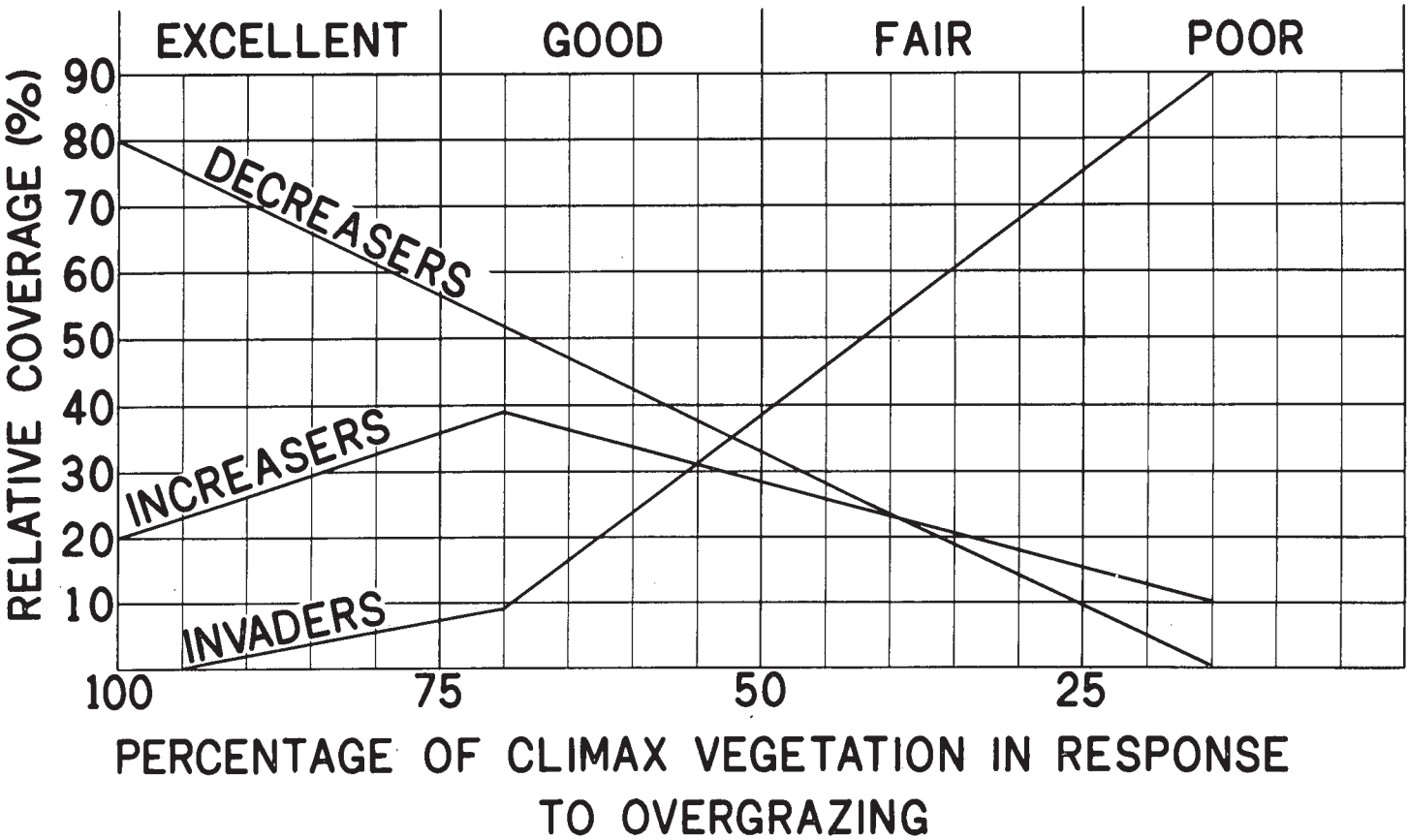


Figure 2.—**Four range-condition classes based on percentage of climax vegetation, and behavior of climax range plants under increasingly intensive grazing.**

Figure 3.—**Range on right of fence is in fair condition; that on the left is in excellent condition. On the right, tall grasses have been nearly eliminated, and yield has declined. Short grasses now produce most of the forage. Annuals have invaded, and they also have been grazed down.**

growth before winter. Generally, the grass is not grazed until the ground is frozen in winter.

When the vegetation is in the excellent condition class, this site produces more pounds of herbage per acre than any other range site in the county.

SUBIRRIGATED RANGE SITE

This site occurs near major streams and in Sandhill valleys. It is on slightly higher ground than the Wet Land range site and lies at lower elevations than the Sands and Sandy range sites (fig. 4, *B*). Soils in this site are dark and moderately high in organic-matter content. Their texture is variable. The soils are—

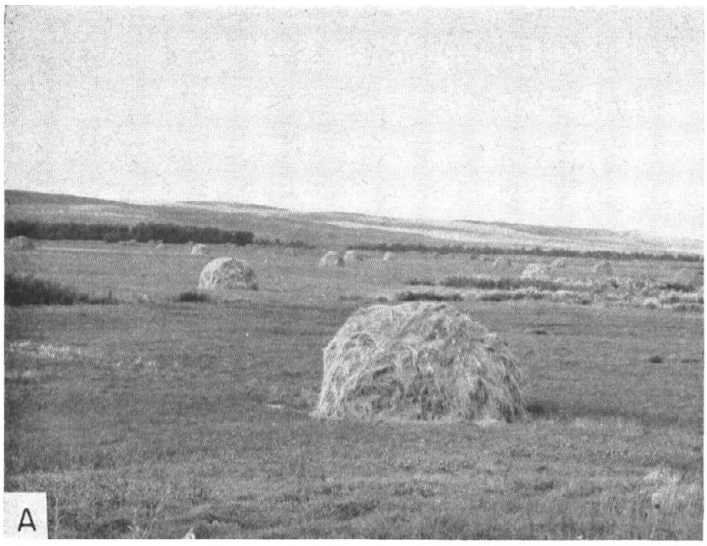
Loup loam.
Elsmere fine sand.
Elsmere loamy fine sand.

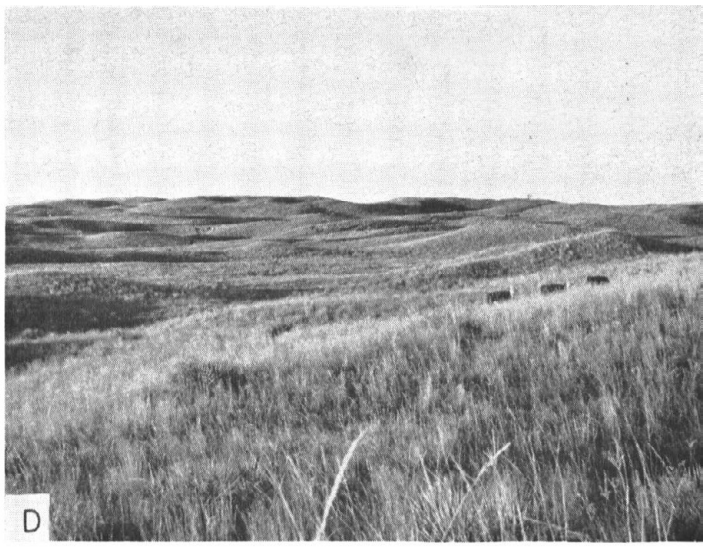
This site supports a luxuriant growth of tall grasses, mainly big bluestem, switchgrass, and Indiangrass. The water table is seldom at the surface, except during the dormant season following snowmelt. The water table is within reach of grass roots during most of the growing season. Commonly, the water table fluctuates between 24 and 48 inches from the surface. The extremes in depth are 12 and 60 inches.

This range site is used mainly for hay, because yield is high and quality is good. It can be grazed, since the water table is normally below the surface after growth starts. In pounds of herbage, this range site is second only to the Wet Land range site.

SANDY RANGE SITE

The Sandy range site consists of soils that are at higher elevations than those of the Subirrigated range site. If there is a water table, it is beyond the reach of grass roots





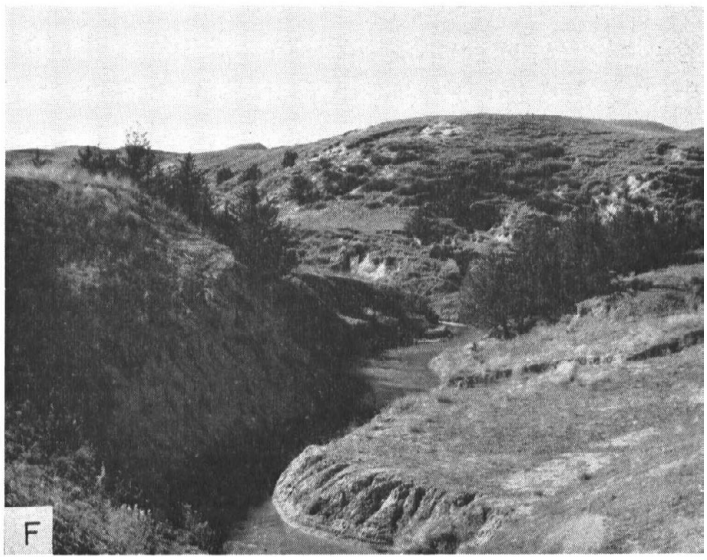


Figure 4.—See explanation on page 8.

685-727—63——2

and does not significantly affect growth of vegetation. The soils of this site are dark, nearly level loamy fine sands or fine sands. They are finer textured and more firm than the soils of the Sands site. The soils of this site are—

Anselmo loamy fine sand, 0 to 1 percent slopes.
Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes.
Dunday loamy fine sand, 2 to 5 percent slopes.
Dunday loamy fine sand, 2 to 5 percent slopes, eroded.
Dunday loamy fine sand, terrace, 2 to 5 percent slopes.

This site supports good growth consisting mainly of tall grasses, with some mid grasses (fig. 4, *C*). In excellent condition class, tall grasses predominate and short grasses occur in small amounts in the understory. As the condition of the range declines, the short grasses increase more than they do on the Sands site. This difference is related to the finer soil texture, which slows the downward movement of moisture and holds more moisture in the upper 2 feet than is held in soils of the Sands site. Once the growth of tall grasses has been depleted, the short grasses have the advantage because their root system is nearer the surface and in better position to use the moisture as it soaks downward.

SANDS RANGE SITE

The Sands range site occurs on low gently sloping hills, in undulating areas, and on the large rolling dunes and round-topped hills.

This site includes loamy sands and fine sands on low hummocky to strongly rolling relief (fig. 4, *D*). The soils are—

Valentine loamy sand, hummocky, eroded.
Valentine fine sand, rolling.

This site supports a mixture of tall and mid grasses, with some short grasses in the understory. Tall grasses are dominant when the range is in excellent condition. Then, prairie sandreed is most abundant, and bluestem, little bluestem, and switchgrass make up an important part of the plant cover.

This site is the most important for grazing, as it occupies the most acres. Overgrazing subjects the soils of this site to wind erosion and causes blowouts.

CHOPPY SANDS RANGE SITE

The Choppy Sands range site occurs on the higher dunes and hills that have steep, complex slopes and sharp peaks and ridges (fig. 4, *E*). Valentine fine sand, hilly, the one soil of this site, has formed on dunes that apparently were blown and reworked later than the dunes of the Sands range site. The amount of organic matter in the grayish-brown surface layer of Valentine fine sand, hilly, varies according to location. On the ridgetops most exposed to wind and sun, the surface layer apparently contains little or no organic matter. On concave slopes and in swales, however, the surface layer may be darkened to a depth of 3 to 5 inches.

These dunes and hills are now generally stabilized with a good cover that has a bunch-grass appearance. In this cover, when it is in the excellent range-condition class, little bluestem, prairie sandreed, sand bluestem, and sand lovegrass are dominant. Prairie sandreed is not so abundant as on the Sands range site. Switchgrass is present, especially on some northeast exposures and in other more favorable locations.

The vegetation is not so dense on this site as on the Sands site, and there is more bare ground. This, plus steep slopes, sharp ridges, and looseness of the sand, makes this site subject to severe wind erosion. Blowouts form wherever the vegetation is overgrazed or otherwise destroyed.

THIN BREAKS RANGE SITE

The Thin Breaks range site occurs along the Dismal and Middle Loup Rivers where silty and sandstone deposits outcrop (fig. 4, *F*). In some places these materials have been covered by thin layers of sand. The site has a drainage pattern that reflects water erosion. The soils of this site are of various depths and textures, too intermingled to be mapped as separate units. They are mapped as a complex—Valentine soils and rough broken land.

The variation in the composition of the vegetation reflects differences in the soils. The more common plants are little bluestem, western wheatgrass, prairie sandreed, sand bluestem, blue grama, and side-oats grama.

Herbage production

Listed below are the range sites of Hooker County, with estimates of herbage production for the sites when in the excellent range-condition class. Two production figures are given for each site. These two sets of figures reflect anticipated variation in annual yields between years favorable and unfavorable for plant growth. The estimated herbage yields are air-dry weights, based on plot samples clipped level with the ground, here and in adjacent Sandhill counties through several years.

Range site:	*Range in pounds of herbage produced on range in excellent condition*
Wet Land	5,500–11,000
Subirrigated	3,500–7,500
Sands	1,500–3,500
Sandy	1,500–3,500
Choppy Sands	1,000–2,200
Thin Breaks	1,000–2,200

The foregoing are estimated potential yields. Each kind of range site produces successively less, in both favor-

EXPLANATION OF FIGURE 4

A. Wet Land range site late in August. The growth shown has taken place since the hay was cut. The haystacks will be moved to higher ground at the edge of the meadow because the water table will rise as plant growth slows down in fall. Marshy strip in right middle distance is too wet to mow.

B. Subirrigated range site mowed for hay.

C. Sandy range site showing typical nearly level relief and good growth consisting mostly of tall grasses.

D. Sands range site showing typical low hummocks and large dunelike hills.

E. Choppy Sands range site showing typical steep slopes, cat steps, peaks, and ridges.

F. Thin Breaks range site along the Dismal River. Silty deposits and soft sandstone of the Ogallala formation have been partly capped with sand of varying depth.

able and unfavorable years, as range condition deteriorates through the good and fair to the poor condition class.

To maintain the yields listed, it is necessary to leave about one-half of the growth unused at the end of the growing season. Greater use than this is the primary cause of downward trend in range condition.

Principles of grazing management

There are four primary requirements that need to be met to practice range conservation through management of grazing:

(1) Proper degree of range use, considering the kinds of range plants to be encouraged in the pasture.
(2) Proper season of use, considering the need of the vegetation for improvement and the need of livestock for forage.
(3) Proper distribution of grazing throughout the pasture, so that, within practical limits, most of the pasture will be grazed to the proper degree.
(4) Proper kinds of livestock, considering the range sites and the kind of forage furnished by range plants.

PROPER DEGREE OF RANGE USE

Degree of range use refers to the amount of the current annual forage growth that is removed by grazing. This is important to the range manager because it affects the physiology of the plant (*5*), which in turn governs its production and ability to compete with the plants around it.

Proper range use is the degree of grazing that will either restore or maintain high range condition. For rapid improvement of range in low condition, proper range use may be light, or even none, during the growing season.

The proper degree of range use on ranges in excellent condition is removal, by grazing, of about half the current year's growth (fig. 5). The growth left on the pasture forms a mulch that slows runoff and erosion and increases intake of moisture for growth the following year.

Figure 5.—**Properly stocked Sandhill range late in August. The cattle are making good gains, have ample forage, and by the end of the grazing season will have taken half of the current season's growth.**

PROPER SEASON OF RANGE USE

The proper time to graze a given range site depends on the characteristics of the site, the range plants it supports, the growth periods of the principal plants, and the range condition. Figure 6 illustrates when to rest or graze a pasture to accomplish one of three purposes.

When range improvement is the main objective, this can be hastened by permitting the grass to grow unmolested for part or all of the growing season. Grazing may be withheld in spring, in fall, or for an entire growing season. The longer the rest period, the more rapidly the range improves toward excellent range condition. If no forage growth is removed, a mulch accumulates rapidly.

REST OR GRAZE NATIVE RANGE DURING PERIODS INDICATED, DEPENDING ON OBJECTIVE

OBJECTIVE	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
MOST RANGE IMPROVEMENT				REST								
IMPROVE WARM SEASON PLANTS				REST								
IMPROVE COOL SEASON PLANTS								REST				
MOST FORAGE						GRAZE						
FASTEST GAINS			GRAZE									

Continue range improvement of rested pastures by proper stocking.

Figure 6.—**Alternative periods of grazing and resting pastures can be used to achieve range improvement, maximum forage, or fastest gains.**

Figure 7.—**Deferred grazing has permitted plants to manufacture food and store it in underground parts. Use of this pasture in the dormant season has lengthened the grazing period and shortened the feeding time.**

This mulch brings more rapid improvement of the range because it creates a condition most favorable to the decreaser plants. The practice of not grazing rangeland for a time during the growth period is called deferred grazing (fig. 7).

PROPER DISTRIBUTION OF GRAZING

If proper degree of range use is to be accomplished over an entire pasture, attention to the distribution of grazing within the pasture requires planning. Livestock tend to graze most in areas near water, on gentle relief, or near roads and trails. Distant corners and steep terrain may be undergrazed.

Poor grazing distribution may be caused by too few watering places, or by having salt, shade, and water at one location. Concentration of livestock causes severe use in only parts of a pasture. Too few watering places or poorly located watering places are the indirect cause of blowouts (fig. 8).

Watering places need to be distributed in a manner that will encourage livestock to graze a pasture uniformly. Distribution of salting locations can supplement water locations in encouraging proper distribution. The salt should be placed in areas where grazing is to be encouraged. Salt should be moved short distances, when necessary, to prevent local overuse and trampling (fig. 9).

In many places it is practical to get better distribution of grazing by fencing different kinds of range sites into separate pasture. The Subirrigated range site, for example, has a very different kind and amount of forage than the Sands site. A fence between these two sites is needed to achieve proper use and distribution of grazing.

KINDS OF LIVESTOCK

Cattle are best suited to graze the vegetation and range sites of Hooker County. A few ranchers raise some horses. Essentially no sheep are grazed in the county.

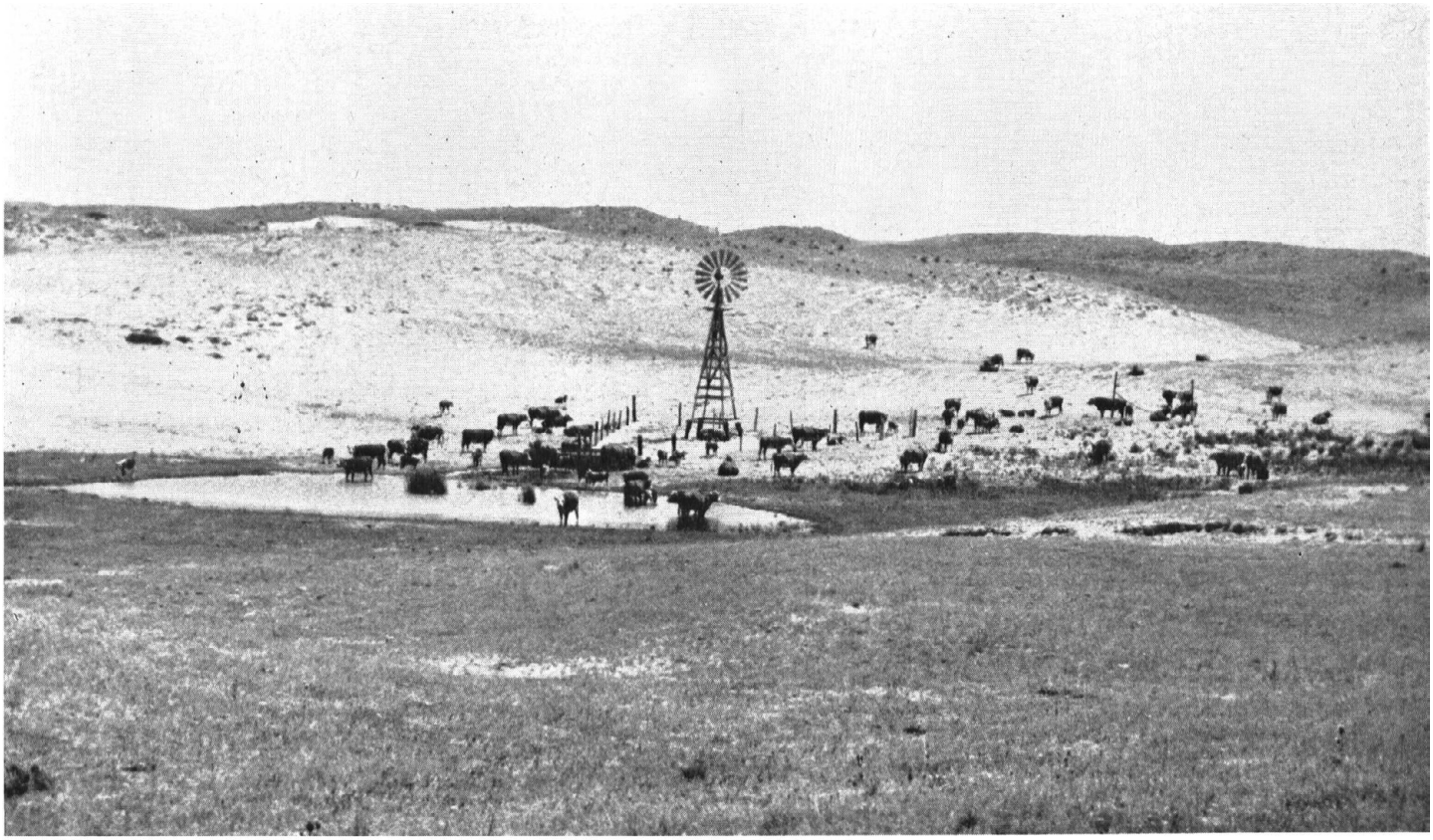


Figure 8.—**Loitering of livestock, excessive grazing, and poor selection of location for a well contribute to formation of blowouts.**

Figure 9.—**Salt, recently placed in this lightly grazed area, attracts cattle, and they graze more in this part of the pasture.**

Range seeding

Range seedings are widely used to improve forage production on formerly cultivated lands. Also, ranges severely depleted by overgrazing may be more economically restored by range seeding than by grazing management alone. Range seedings are designed to restore the original type of plant cover for the site.

Range seedings are appropriate for nonarable lands (capability classes VI and VII), and anywhere in this county where the landowner wishes to avoid further cultivation after the seeding is established. Among the latter may be areas suitable for cultivation (classes III and IV) that are too small to be cropped or to be managed as a separate tame pasture.

Native grasses can be re-established in Hooker County if the seedbed is properly prepared, an appropriate mixture of local strains of native species is used, the correct seeding method is employed, and the new seeding is protected until it is well established (fig. 10, *A*).

Seedbed.—A firm seedbed, protected from wind and water erosion, is necessary. A crop is planted for cover, preferably milo or sorghum. Sufficient growth is left to prevent soil blowing, but not a quantity that will prevent a drill from penetrating the soil. A standing stubble 10 to 18 inches high is preferred. The grass seed is drilled in the standing stubble (fig. 10, *B*).

For areas with loamy fine sand and coarser soils, seedbed preparations and seeding are done best in narrow strips. Thus, the entire area is not exposed to wind erosion at one time.

Method.—Seed is planted with drills equipped with seedboxes that permit easy, even flow of both the light fluffy seeds and the small seeds. Depth bands can insure proper and uniform planting depth. A set of packing wheels, attached to the drill or to a separate packer, is needed to pack the soil around the seeds.

The Valentine loamy sand, hummocky, eroded, and severely blown soils have high susceptibility to erosion. Areas that include these soils can be planted with a range interseeder that places the seeds at the center of a shallow, wide, cleared furrow (fig. 10, *C*). This method of seeding is favored, also, for rangeland that has a sparse stand of one or two desirable native species that might be difficult to replace.

Interseeding requires management of grazing that will permit the planted grasses to first occupy the cleared furrow and then to spread into the areas between the planted rows, where competition from weedy plants may be keen (fig. 10, *D*).

Mixture.—Seed of adapted strains of native grasses must be used in seeding mixtures. Suitable mixtures for the different range sites are shown in table 3. The amounts shown are for pounds of pure live seed, which are computed by multiplying percentage of purity by percentage of germination. Acceptable substitutes for species listed in table 3, and alternate choices of seeding mixtures, can be obtained from local offices of the United States Department of Agriculture.

TABLE 3.—*Seeding mixtures suitable for four range sites*

[Grasses identified by the term "warm season" make most of their growth during hot summer months; those identified by the term "cool season" make most of their growth in spring or fall]

	Pounds per acre pure live seed [1] on range site named			
	Wet Land	Subirrigated	Sandy	Sands
Tall-grass mixture (cool season):				
Reed canarygrass	0. 7	0. 1		
Reedgrasses	. 9	. 1		
Tall-grass mixture (warm season):				
Big bluestem	. 3	1. 6		
Indiangrass	. 3	1. 3	0. 6	0. 8
Switchgrass	. 2	. 6	. 3	. 3
Sand bluestem			. 9	1. 2
Mid-grass mixture (warm season):				
Little bluestem		. 2	. 6	. 7
Side-oats grama		. 2		
Sand lovegrass			. 1	. 1
Mid-grass mixture (cool season):				
Western wheatgrass			. 7	
Green needlegrass			. 4	. 4
Canada wildrye			. 6	. 6

[1] Pounds of pure live seed is the pounds of seed, times the percentage of purity, times the percentage of germination.

Protection and Management.—It is essential to limit grazing of new seedings to the dormant season until the stand is sufficiently dense to essentially exclude annuals. Fences are maintained around new seedings a number of years after grazing starts, to prevent concentration of livestock on them. Proper range use and other range practices are necessary to maintain range seedings after full establishment.

Figure 10.—**Range seeding. *A*, Good stand of native grasses established by seeding on the Sandy range site. *B*, Cover crop of grain sorghum on sandy land that was once farmed; a mixture of native grasses will be sown in the sorghum stubble next spring. *C*, Range interseeder, developed by the Soil Conservation Service, is used to seed climax native grasses in strips where cultivation of the whole pasture is not desirable or feasible. *D*, Under proper range use, these rows of dominant climax grasses will in time crowd out the weedy growth between rows.**

Managing Native Meadows

Some areas in Hooker County, mostly those in the Wet Land and the Subirrigated range sites, are mowed each year for hay. (See figs. 4, *A* and 4, *B*.) These sites cover about 3,876 acres in the county, and the hay cut from them is ordinarily stacked. Hay is mowed in other areas but is seldom stacked; it is windrowed or baled and left on the pastures that are to be grazed in fall and winter.

Mowing has reduced the amount of tall grasses and sedges and nearly eliminated the forbs that originally grew on meadows in this county. The meadows now produce ½ to 2½ tons of hay per acre, the actual amount depending on the range site and the condition of the plant cover. Current production can be maintained, or improved, most economically by adjustment in mowing time and in frequency of mowing.

Mowing time and height.—If meadows are to remain productive, the plants need time during the growing season in which they can store carbohydrates in their roots. Maximum storage occurs when the plant is ripening and its spring growth of foliage is drying (*8*). This time, however, is different for the different plants in the meadow. If the stand is left until all the plants have stored maximum carbohydrates, mowing is done when the plants are turning yellow or brown. Meadows mowed at such time produce more forage than if mowed earlier, but the content of protein, phosphorus, and carotene is less. Livestock eat the early cut hay better and they make better gains on it (*2*).

Ranchers need to weigh the higher nutritional value of hay cut early against the greater yield to be gained by cutting late, and against the depleting effect early cutting has on the meadow. Early cutting depletes forbs and

native legumes more than grasses (*3*), but it affects all the plants in the meadow.

Experience indicates that the practical solution is to cut meadows early enough to allow good regrowth and numerous seedstalks by the end of the growing season. Ordinarily, the regrowth can be grazed after the growing season, but there are exceptions to this. On the Sands and the Sandy range sites, all the regrowth is needed to hold snow and to increase soil moisture. On the Subirrigated and the Wet Land range sites, grazing of the regrowth can be started after the first killing frosts without apparent decrease in yield the following year.

Cutting and windrowing or baling of hay on the Sands range site should not be done more often than once in 3 years. On this range site, a pasture mowed in one summer should not be grazed during the next growing season, but it can be grazed in fall and winter following the growing season.

Mowing time is frequently more important than height of mowing, but height of mowing does affect storage of carbohydrates. Mowing removes most of the meristem tissue, or growth points, from most forbs and from some of the tall grasses and sedges in meadows. In grasses the majority of the new bud shoots start at or below the soil surface. It takes time for these shoots to put up enough growth to manufacture a good supply of food.

When upland pastures are mowed, the tall and mid grasses lose a high proportion of the green foliage in which food is manufactured. In contrast, blue grama and other short grasses lose only the tips of their leaves and therefore can grow while the mid and tall grasses are starting new shoots. In this way, the less productive short grasses gain advantage over the taller, more desirable grasses. If height of mowing is adjusted with this in mind, the taller grasses are at less disadvantage.

Haying methods.—Ranchers in this county have devised efficient haying methods (fig. 11). Practically all of the ranches are fully mechanized; only a few ranchers use horses to pull stacks and to feed cattle in winter.

The ranchers use tractor mowers (fig. 11, *A*), wide rakes, fast-traveling sweeps, and fast, low-cost stackers. Many ranchers can put up a 4- to 6-ton stack in 20 minutes. The stacks are made this size so that they can be hauled on a low-bed rack (fig. 11, *B*), which is variously called a cabling rack, hay sled, underslung, or flat rack. To load a stack, the bed of the rack is tilted down beside the stack, and one end of a steel cable is fastened to the rack. The cable is then placed around the base of the stack, and the other end is hooked to a tractor or a four-horse team. The haystack is pulled onto the rack as the cable is tightened (fig. 11, *C*). Skilled operators leave essentially no hay on the ground. The hay may be moved some distance before feeding, or it may be fed on the meadow where it was cut. Many ranchers prefer to feed on the meadow, as the waste hay and manure help to maintain productivity of the meadow.

The methods of stacking and feeding just described are those used on the range sites ordinarily cut for hay. The acreage of hay meadow is not large, however, and many ranchers must mow parts of range pasture that will be grazed in fall and winter. They rake the hay into windrows or bale it and leave most of it on the pasture (fig. 11, *D*). This is more economical than hauling it to the cattle. During most of the fall and winter, the cattle can go to this hay when they want it. Some of the hay is stacked or baled and hauled in to meet emergencies—periods of heavy snowfall, severe cold, or similar bad weather.

Protein supplements are fed in varying amounts, depending on the class of cattle and the quality of the hay or winter range. Cattle on winter range and windrowed hay receive more supplements than those on range that are fed stacked or baled hay.

Control of Blowouts

At the time this survey was made, 2,185 acres in Hooker County was occupied by blowouts larger than 5 acres in size, and there were many blowouts smaller than 5 acres. The blowouts occur most frequently along trails in the Choppy Sands range site and in formerly cultivated fields in the Sands range site (fig. 12, *A*).

Blowouts start when vegetation is destroyed by tillage or by livestock trampling, trailing, or grazing close. Most of the large blowouts have started at wells, mainly because livestock concentrate near the water.

Blowouts start where vegetation has been destroyed, and they spread if they are not stabilized. Strong wind whips sand from the exposed area to bordering areas still vegetated, where the sand cuts the plants, exposes their roots, or buries them.

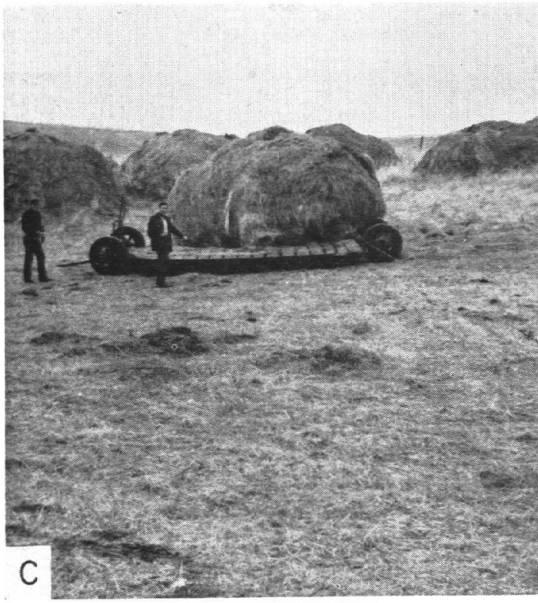
The prime problem in controlling blowouts is holding the sand in place until vegetation can stabilize it. For effective control, the broad bare areas and vertical banks that are sources of sand must be eliminated.

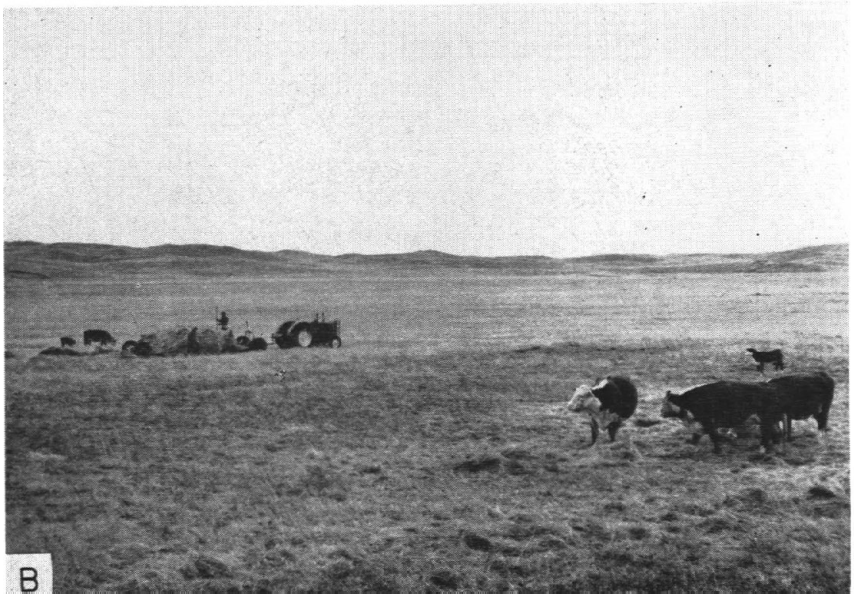
Many blowouts have been stabilized by fencing them to exclude livestock. If there is a source of seed, annuals and weedy plants volunteer. They may essentially stop the drifting sand in a year, or they may require several years. When the annuals and weeds have controlled soil blowing, the native perennial grasses work in from the edges (fig. 12, *B* and *C*).

Man can help reclaim blowouts and shorten the time for stabilization. The large bare areas on the larger blowouts can be seeded to a quick-growing summer crop. Sorghums have been most effective. The summer crop is normally planted after the period of intense wind and when plant growth is rapid. The following year, a mixture of native grasses is drilled into the dead cover left by the summer crop. If vertical banks occur in or around the blowout, they are smoothed to a 3 to 1 or a flatter slope. Without grading, the banks are too steep to produce grass and are a constant source of drifting sand. The sand moved and reworked in sloping the banks is usually too dry to start a cover crop. It is best to hold it in place with a mulch. These reworked areas should be packed and planted to a native grass mixture before the mulch is applied. The mulch should be held in place with sand or stakes, by treading the plant material into the sand, or by spraying the plant material with a light coating of RC–2 asphaltic oil.

Small blowouts with steep banks can be quickly stabilized by sloping, packing, seeding, and mulching as just described for the larger blowouts.

Where blowouts are too numerous, or where fencing is otherwise impractical, pastures may be set aside for grazing only in fall or winter. Stabilized blowouts may be grazed lightly and with caution.





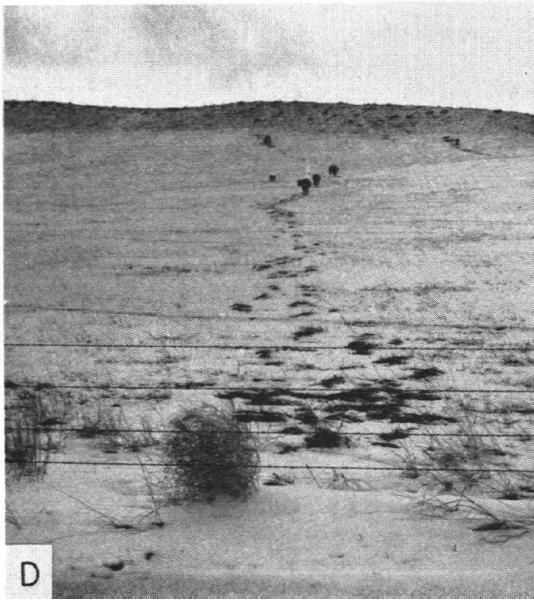


Figure 11.—Haying methods in Hooker County. *A*, Tractor with mower attachment pulling a mower designed for horsepower. *B*, rack. *C*, Sliding an entire stack onto a low-bed rack. *D*, Winter pasture showing windrowed hay in foreground and stand

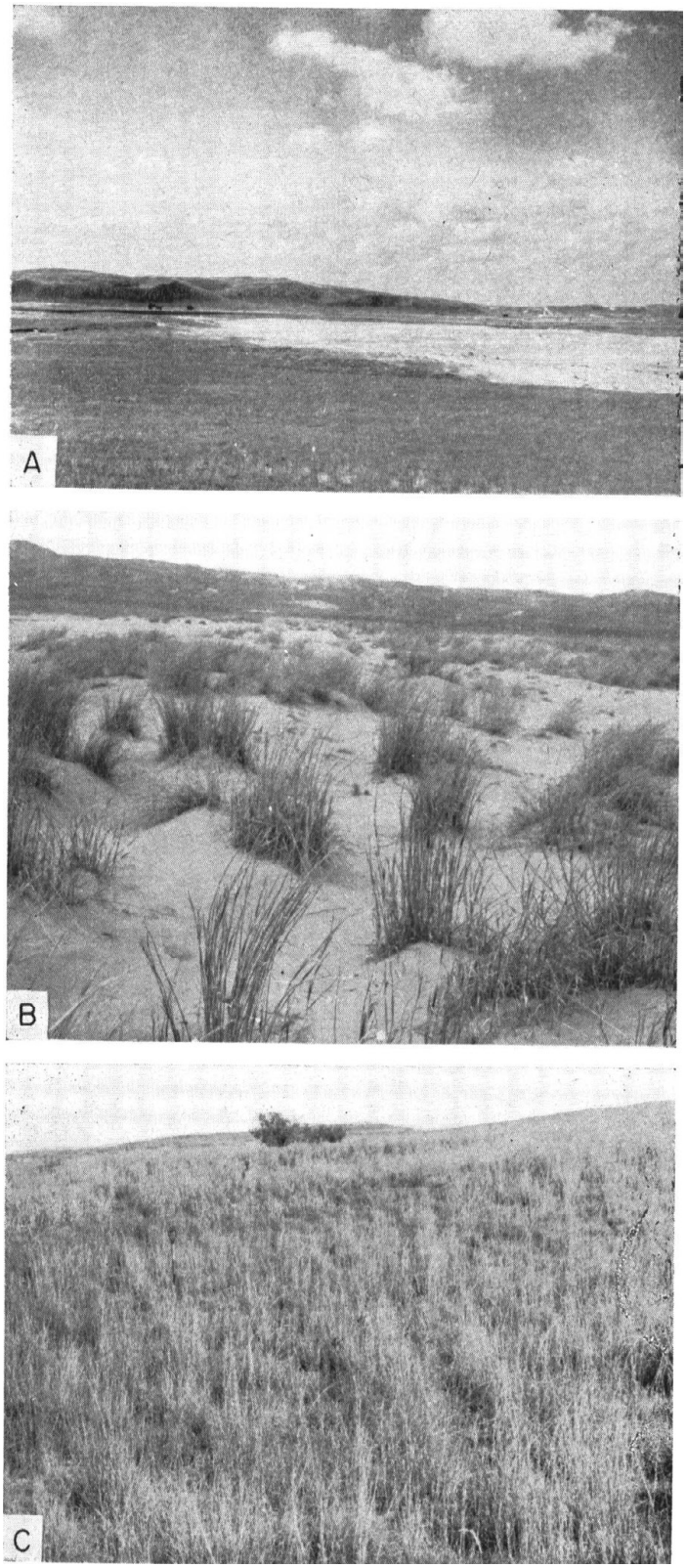


Figure 12.—Stabilizing blowouts. *A*, Blowout on a cultivated field that was fenced into a pasture and a well drilled on it. *B*, Wind blows sand from bare area on left into sand bluestem struggling to reclaim blowout. *C*, Grass that was not grazed or mowed has completely stabilized this blowout.

Managing Cropland

Soils used for cultivated crops occupy less than 2,000 acres in this county and are used mainly to produce supplemental pasture and winter feed for livestock. The soils under cultivation are the well-drained soils in the nearly level upland valleys and on stream terraces. Included are the Dunday soil on the stream terraces along the Loup River; the Anselmo and Dunday soils in the enclosed valleys; and some areas of Valentine loamy sand, hummocky, eroded, which occur within larger tracts of other soils that are cultivated.

Estimated yields

Shown in table 4 are estimated yields of corn, rye, rye and vetch, and alfalfa on the soils of the county commonly cultivated. The estimates are based on interviews with farmers and ranchers who have limited recorded data. In many instances, crops are grazed rather than harvested; hence, no definite yield can be measured.

TABLE 4.—*Estimated acre yields of the principal crops on the cultivated soils in Hooker County* [1]

Soil	Corn	Rye	Rye and vetch	Alfalfa	
				Dry-land	Irri-gated
	Bu.	*Bu.*	*Tons*	*Tons*	*Tons*
Anselmo loamy fine sand, 0 to 1 percent slopes	25	12	1.00	1.25	3.00
Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes	22	10	.85	1.00	2.75
Dunday loamy fine sand, 2 to 5 percent slopes	18	8	.75	1.00	2.50
Dunday loamy fine sand, 2 to 5 percent slopes, eroded	18	8	.75	1.00	2.50
Dunday loamy fine sand, terrace, 2 to 5 percent slopes	18	8	.75	1.00	2.50
Valentine loamy sand, hummocky, eroded	10	5	.60	.50	2.00

[1] Data obtained by interviews with farmers and ranchers.

All the cultivated soils are managed at about the same level. Vetch or alfalfa is used as a soil-building crop; the soils are protected with crop residues; and crops are grown in alternate strips to control wind erosion. The cultivated soils are sandy and similar in nature. On soils with similar slope and depth of surface soil, there is little difference in yield.

If the cultivated soils are not protected, they are rapidly damaged by wind erosion. Addition of fertilizer high in nitrogen and phosphate might double yields in wet years, but rainfall is not consistent enough to assure that regular use of commercial fertilizer will be profitable. Phosphate is used on irrigated alfalfa to increase yields. More generous use of phosphate and lime would help to raise yields of this crop.

Dryland cropping practices

Corn, rye, and vetch are the main crops produced by dryland farming. Other crops have been grown but have

not proved successful. Oats, barley, and other spring-sown small grains have not proved profitable. Grain sorghums have failed to mature in most years because of the cool nights. Forage sorghums are sometimes grown for livestock feed. Alfalfa is seldom grown on dryland because it is difficult to get a stand and yields are low. The alfalfa seedlings die for lack of water or are killed by blowing sand.

Corn is planted with a lister with little or no ground preparation. Thus, the soil is rough and protected from the wind at planting time. By the time the lister ridges have weathered down, the corn is tall enough to protect the soil from the wind. Then, in fall, rye, or a mixture of rye and vetch, is sown in the corn rows to provide cover during winter. The corn is picked, or it is grazed along with the cover crop.

If the cover crop looks good the following spring, it is left and cut for hay or grain. Rye is then planted again in the fall. If the prospects of a rye crop do not look good in spring, the rye is pastured until corn-planting time, and the field is again planted to corn with a lister.

Irrigation cropping practices

Alfalfa, usually mixed with bromegrass, is the main crop grown under irrigation. Phosphate fertilizer, and sometimes lime, is needed to get good stands and to maintain high yields. Trace elements, such as sulfur, also may be needed. The crop must be irrigated frequently because the sandy soils have low water-holding capacity. When stands of alfalfa get thin, they are plowed out and the fields are reseeded to alfalfa and bromegrass. About 400 acres of land is irrigated by sprinklers. The water is obtained from deep wells or from the Middle Loup River.

Control of erosion

Soil blowing, or wind erosion, is a major problem on the soils of this county (fig. 13). Water erosion is slight because the sandy soils absorb most of the water that falls.

The soils in many fields once cultivated have been destroyed by wind erosion. The soils now cultivated are in danger of destruction unless they are protected. The practices that best control wind erosion on the soils of this county are growing of cover crops, stripcropping, and conserving of crop residues.

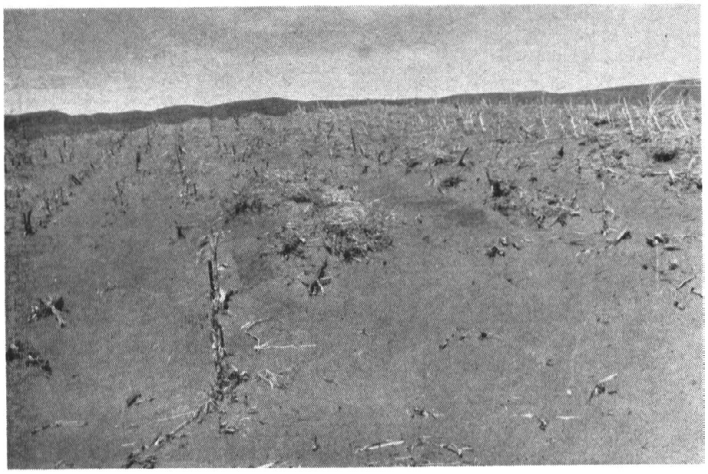


***Figure 13.*—Wind erosion on a cornfield grazed during winter and not protected by a cover crop.**

The cover crop normally used in this county is rye and vetch planted together in cornfields in fall. This cover protects the soil from blowing during the winter and spring. The vetch is a legume and is able to add nitrogen to the soil.

Stripcropping, the planting of different crops in strips 10 to 15 rods wide, leaves strips of growing crops or crop residues to protect the soils from wind while new crops are being established in the alternate strips.

Grain stubble or cornstalks are crop residues effective in protecting the soils. If these are grazed off, the soils are left unprotected. The amount of protective residue can be increased in years of favorable moisture by adding fertilizer. Legumes, such as vetch, add to the supply of nitrogen and thus encourage growth of more crop residue.

Alfalfa, grasses, and similar close-growing crops protect the soils during all seasons.

Capability groups of soils

The capability classification is a grouping of soils that shows, in a general way, how suitable the soils are for most kinds of farming. It is a practical grouping based on the limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no susceptibility to erosion but have other limitations that limit their use largely to pasture, range, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are assigned locally, for example, IIIe–5. The arabic number assigned to a unit has no purpose other than to identify the unit.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of the permanent limitations, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils, and without consideration of possible but unlikely major reclamation projects.

The following list defines the eight classes in the capability system and describes the subclasses and capability units that occur in Hooker County.

Class I.—Soils that have few limitations that restrict their use. (None in this county.)

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices. (None in this county.)

Class III.—Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.

Unit IIIe–5: Deep, dark, moderately sandy soil in level valleys; slightly eroded.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, or that require very careful management, or both.

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

Unit IVe–5: Deep, very sandy, moderately dark soils in nearly level valleys; slightly to moderately eroded.

Subclass IVw.—Soils that have very severe limitations for cultivation because of excess water.

Unit IVw–5: Very sandy soil that is imperfectly drained.

Class V.—Soils not likely to erode but that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or wildlife food and cover.

Subclass Vw.—Soils too wet for cultivation; drainage or protection not feasible.

Unit Vw–1: Wet, silty soils.

Unit Vw–5: Wet, sandy soil.

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or wildlife food and cover.

Subclass VIe.—Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit VIe–5: Light-colored, very sandy soils that are on rolling slopes and are slightly or moderately eroded, or that are on hummocky slopes and are severely eroded.

Subclass VIw.—Soils moderately affected by excess water.

Unit VIw–5: Loose, sandy soil that is imperfectly drained.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing or wildlife food and cover.

Subclass VIIe.—Soils very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit VIIe–5: Very light colored, very sandy soil on steep, choppy slopes.

Subclass VIIs.—Soils very severely limited by moisture capacity, stones, low fertility, or other soil features.

Unit VIIs–3: Moderately sandy to very sandy soils mixed with outcroppings of bedrock on very steep slopes.

Class VIII.—Soils and landforms that, without major reclamation, have limitations precluding their use for commercial production of plants, and that restrict their use to recreation, wildlife, water supply, or esthetic purposes. (No named soils of this class in the county, but some areas on map identified by marsh symbol are in this class.)

Management by capability units

In the following pages the capability units, or groups of soils similar in management requirements, are described; their limitations are pointed out; and appropriate management is mentioned.

CAPABILITY UNIT IIIe–5

The only soil in this capability unit is Anselmo loamy fine sand, 0 to 1 percent slopes. It is a deep, dark, moderately sandy soil in smooth, nearly level parts of enclosed valleys.

This soil is well drained but moderately low in water-holding capacity and fertility. It has been slightly eroded where cultivated, and it is subject to further wind erosion unless adequately protected. Soil-building crops are needed to build up and maintain its fertility. Legumes, suitable as soil-improving crops, will need phosphate fertilizer and lime in amounts determined by soil tests.

This soil is suited to irrigation if it is protected from wind erosion. Only sprinkler irrigation is now used. For gravity irrigation, land grading would be required, and lined ditches or pipe would be needed to conserve water.

CAPABILITY UNIT IVe–5

In this unit are deep, very sandy soils in enclosed valleys and on nearly level to gently sloping terraces. They are well-drained soils low in water-holding capacity and fertility. The soils are—

Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes.
Dunday loamy fine sand, 2 to 5 percent slopes.
Dunday loamy fine sand, 2 to 5 percent slopes, eroded.
Dunday loamy fine sand, terrace, 2 to 5 percent slopes.

These sandy soils have been moderately eroded where cultivated. Wind has blown much of the binding silt and organic matter out of the plow layer. The loose material blown from the plow layer has accumulated in low hummocks and will readily blow again unless it is protected.

Soil-building crops are needed to restore and to maintain fertility. Legumes, suitable as soil-building crops, need phosphate and lime in amounts determined by making soil tests.

These soils are fair to poor for irrigation. They generally do not lend themselves to gravity irrigation. They are undulating and too sandy. If they are irrigated, they must be protected from wind erosion.

CAPABILITY UNIT IVw–5

The one soil of this unit, Elsmere loamy fine sand, is in nearly level, imperfectly drained valleys. The soil is mod-

erately fertile, and its water table generally is at a depth between 30 and 60 inches.

In dry years this soil is subject to wind erosion if it is cultivated and not adequately protected. In spring, it is often too wet to cultivate. The high water table, however, encourages growth of grass. Most of this soil is now in native grass. Because it has a favorable water supply, it should respond well to commercial fertilizer.

CAPABILITY UNIT Vw-1

In this unit are deep, dark, poorly drained, loamy soils that occur in nearly level, wet depressions on the bottom lands. The soils are—

Gannett sandy loam.
Loup loam.

Sedges, prairie cordgrass, reed canarygrass, reedgrasses, and similar water-tolerant plants do best on these soils. The reed canarygrass has been introduced in some meadows and has increased their yield.

These soils are too wet for cultivation and are best utilized for hay. In some years they are too wet for hay production. Some of the meadows can be improved by devices to regulate the water table; for example, pumps to remove excess water, and gates in drainage ditches to control the water table.

Field trials with phosphate fertilizer on these soils have not consistently given adequate returns. Alsike clover can be established successfully on some of the better drained areas.

CAPABILITY UNIT Vw-5

The one soil of the unit is Loup fine sand, a very sandy, poorly drained soil on nearly level, wet bottom lands. Sedges, prairie cordgrass, reed canarygrass, and reedgrasses do best on this soil. The reed canarygrass introduced on some meadows has increased yields.

This soil is too wet for cultivation and includes small areas of marsh too wet even for hay. It is used mostly for production of hay. Phosphate fertilizer applied in field trials has not given adequate returns consistently. Alsike clover can be established successfully in the better drained areas.

CAPABILITY UNIT VIe-5

This unit is made up of deep, very sandy soils on hummocky and rolling slopes. The soils are well drained to excessively drained. They are—

Valentine loamy sand, hummocky, eroded.
Valentine fine sand, rolling.
Blown-out land.

Valentine fine sand, rolling, is an extensive soil under native grass. It occupies about 85 percent of Hooker County. Valentine loamy fine sand, hummocky, eroded, is a very sandy soil not suitable for cultivation. It occupies slightly less than 500 acres in the county, and areas of it under cultivation should be seeded to permanent grass. Reseeding methods are discussed under the heading "Range Seeding" in the section on use and management of grassland.

Blown-out land now included in pastures should be protected from grazing and reseeded to native grasses. Methods of stabilizing blowouts are discussed under the heading "Control of Blowouts" in the section on use and management of grassland.

CAPABILITY UNIT VIw-5

The one soil of this unit, Elsmere fine sand, is a deep, loose, imperfectly drained sandy soil in nearly level depressions and on bottoms.

This soil is not suitable for cultivation; it is too loose and sandy. It produces a good growth of tall grasses. The yield and quality of forage usually improve if phosphate is applied and red clover is interseeded in the native grasses. The seasonally high water table encourages the growth of grasses.

CAPABILITY UNIT VIIe-5

The only soil of the unit, Valentine fine sand, hilly, is a deep, loose sand on the larger and steeper dunes marked with catsteps. Its profile is fairly uniform throughout.

This soil is too sandy and steep for cultivation. It produces a fair crop of native grass when carefully managed. It is easily eroded by wind if the plant cover is not maintained.

CAPABILITY UNIT VIIs-3

The soils of this capability unit are mapped as one soil complex, Valentine soils and rough broken land. The Valentine members of the complex are deep, loose sands; the rough broken land, which occurs where silt and sand from the Ogallala formation is exposed, is deep to shallow, moderately sandy, and on rough broken slopes. Outcrops of the soft, fine-textured Ogallala sandstone occur in many places.

Soils of this complex are too sandy and steep for cultivation. They produce a fair crop of native grass when properly managed. Grazing must be carefully controlled to prevent erosion.

Management of Woodland and Shelterbelts [3]

Few native trees grow in Hooker County, and they are chiefly along the Middle Loup and Dismal Rivers and their tributaries. Since settlement, spread of native trees to other parts has been somewhat encouraged by overgrazing of grasslands, which gives the trees some advantage, and by control of prairie fires.

The native trees growing in this county have little commercial value other than for the few posts or poles they provide. The kinds of trees differ somewhat according to location. Scattered cottonwoods, black willows, diamond willows, boxelders, and sandbar willows grow in the low wet areas (fig. 14, *A*). On the higher, steeper breaks along the rivers are redcedar, hackberry, green ash, American elm, and boxelder (fig. 14, *B*).

The more common native shrubs are American plum, western sandcherry, western chokecherry, threeleaved sumac, black and golden currants, gooseberry, elder, dogwood, buffaloberry, wolfberry, raspberry, leadplant, sage, and indigobush.

Planting windbreaks.—Planting of windbreaks around ranch headquarters began shortly after the early settlers arrived and has been going on since. The need for wind-

[3] By SIDNEY S. BURTON, woodland conservationist, Soil Conservation Service.

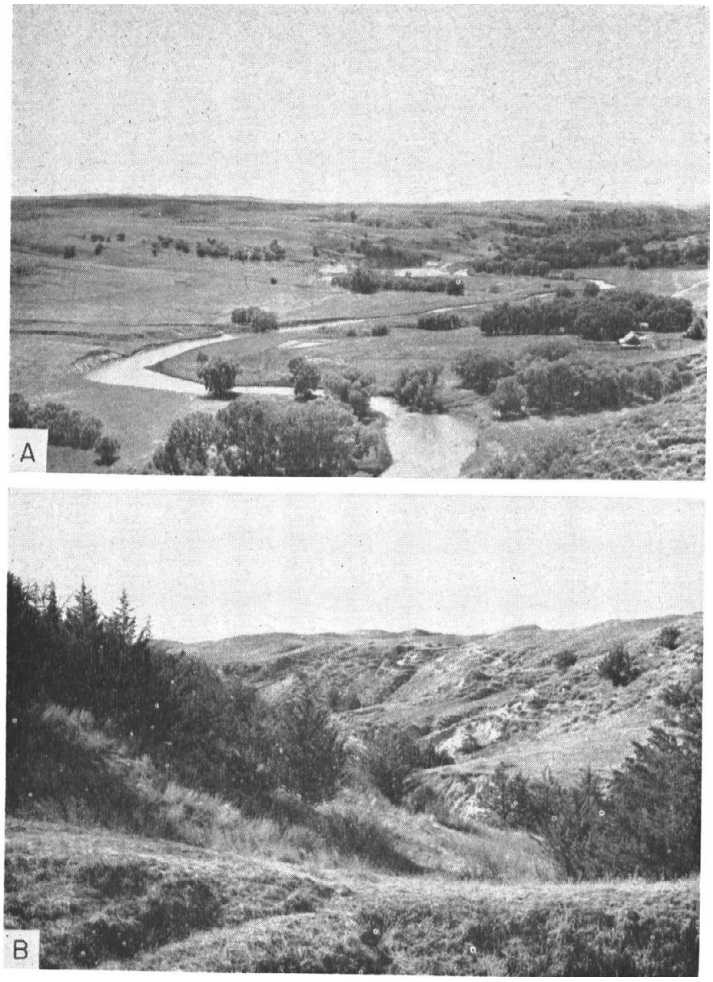


Figure 14.—**Tree cover in Hooker County. *A*, Cottonwoods, willows, and boxelders on wet land along the Middle Loup River. *B*, Typical growth of redcedar on Thin Breaks range site bordering the north branch of the Dismal River.**

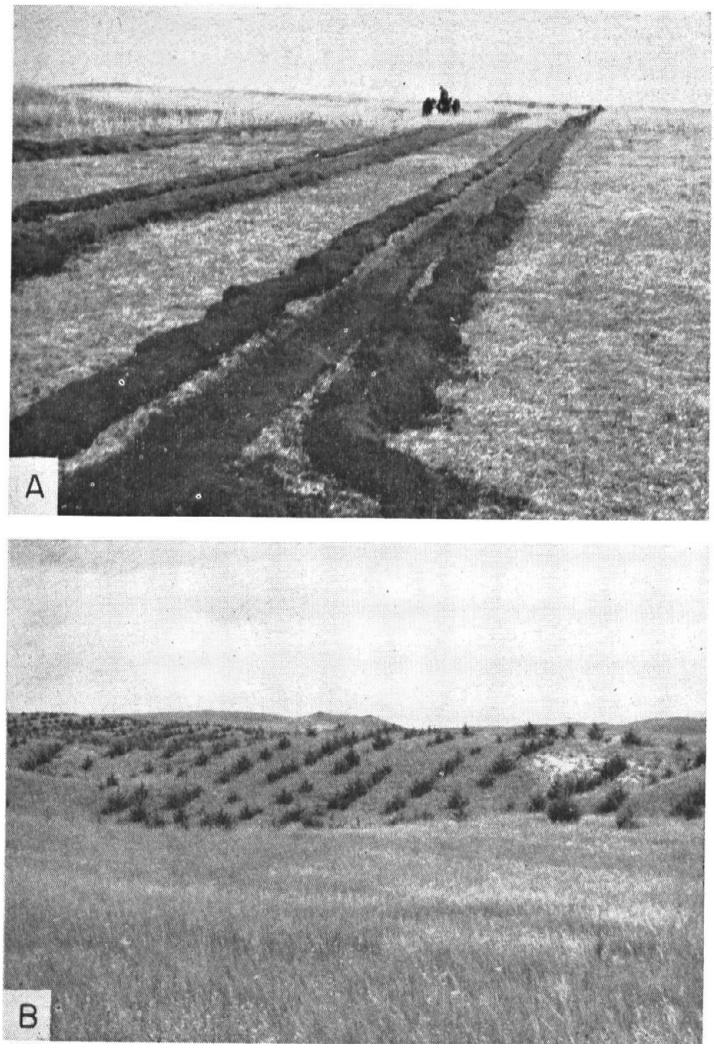


Figure 15.—**Tree planting. *A*, The Soil Conservation Service has developed a machine that opens a shallow furrow 20 inches wide in which trees are planted. The furrow retards growth of competing native vegetation until the young trees have become established. *B*, Young planting of redcedar that will provide winter protection for livestock and harbor deer, grouse, and other wildlife.**

breaks for winter protection of livestock has long been recognized. Successful planting of trees in the Nebraska National Forest, in adjacent Thomas County, has greatly encouraged planting of redcedar and pine to protect livestock in winter (fig. 15, *A* and *B*). Because the soils in the greater part of the county are sandy, preparation for planting must be no more than the opening of a shallow furrow in the sod and placing the young trees in the furrow.

Cultivation of the trees after planting is not practical on the sandy soils, and for this reason, only redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, and similar conifers are suitable. These conifers can withstand the competition of the native grasses fairly well. Broadleaf species, in contrast, must be cultivated if they are to survive. Broadleaf species can be used on wet and subirrigated areas where the site can be prepared by plowing and disking a 4- to 6-foot strip for each row of trees. Strips of sod are left between these cultivated strips to minimize soil blowing.

Windbreaks planted to protect livestock in winter are best if they are wide enough to hold all the drifting snow within the belt. Normally, this requires a minimum of 10 rows, and preferably 15 to 20 or more. The belt planted should be long enough that cattle will not concentrate in a small area and trample the grass.

Redcedars, planted 4 to 6 feet apart in the row, make a good tight barrier for the windward side of the windbreak. Pine trees, 10 feet apart in the rows, are good for the rest of the windbreak. After the pine trees are 10 to 12 feet high, livestock can be allowed to seek shelter under them during storms. The trees are not seriously damaged if they are used for shelter for only a short time.

Because the soils of the county differ in their suitability as sites for windbreaks, they have been placed in five windbreak suitability groups. These groups, and the kinds of trees suitable for planting on soils of each group, are shown in table 5.

TABLE 5.—*Windbreak suitability groups and suitable species for planting*

Site description, soil series, and map symbols	Species suitable for planting		
	Shrubs	Conifers	Broadleaf trees
Sandy site. Slightly sandy soils and nearly level very sandy soils. Anselmo (Ao). Dunday (DA, DuB, 2DuB, DuB2).	American plum. Western sandcherry. Three-leaved sumac. Honeysuckle.	Redcedar. Rocky Mountain juniper. Ponderosa pine.	Boxelder. Green ash. Honeylocust. Siberian (Chinese) elm. Cottonwood.
Very Sandy site: Very sandy soils and loose sands that cannot be safely cultivated. Blown-out land (B). Valentine (VaC, VaD, VcB2). Valentine soils and rough broken land (VR).	None.	Redcedar. Ponderosa pine.	None.
Moderately wet site: Soils of bottom lands, benches, and upland depressions that are occasionally wet because of a high water table or frequent flooding for a short time. Elsmere (Ea, Eb).	Purple willow. Red-osier dogwood. Chokecherry. Buffaloberry.	Redcedar. Scotch pine.	Diamond willow. Russian olive. Boxelder. Golden willow. Green ash. Honeylocust. Cottonwood. White willow.
Wet site: Soils of bottom lands, benches, and upland depressions that are wet most of the time because of flooding, high water table, or poor drainage. Gannett (Gn). Loup (Ld, Lm).	Purple willow. Red-osier dogwood.	None.	Diamond willow. Laurel-leaf willow. Golden willow. White willow. Cottonwood. Silverleaf poplar.

Wildlife and Its Management [4]

The combination of soil and climate in Hooker County produces a climax vegetation consisting primarily of grasses, in an area characterized by occasional lakes and marshes and a few intermittent and continually flowing streams (fig. 16). The kinds and amounts of wildlife that can be produced and maintained in the county are largely determined by the kinds and amounts of vegetation the soils can produce, and by the manner in which this vegetation is distributed.

Wildlife is influenced by topography, and by such soil characteristics as fertility. Fertile soils are capable of greater wildlife production than less fertile soils, and waters that drain from fertile soils generally will produce more fish than waters that drain from infertile soils. Topography affects wildlife through its influence on land use. Extremely rough, irregular areas may present hazards to livestock, and the undisturbed vegetation in such areas is often valuable to wildlife. If suitable vegetation is lacking in such areas, it often can be developed to improve conditions for desirable kinds of wildlife.

Wetness and water-holding capacity of the soils are important in selecting sites for constructing ponds for fish and in developing and maintaining habitats for waterfowl. Swampy and marshy areas lend themselves to development of aquatic and semiaquatic habitats of value to waterfowl and to some species of furbearers.

Factors of the kind mentioned in the foregoing paragraphs were considered in preparing table 6, which shows the potential of the soil associations in the county for producing habitats for the more important species of game in Hooker County. The last column in the table, titled "Food," shows, by means of ratings, the capacity of the soil association to provide the kinds of food plants needed by the kind of wildlife specified.

The soils of Hooker County still provide suitable habitat for a number of wildlife species. Some species, as elk and buffalo, are no longer found in the county. Others, particularly deer and grouse, are still present. Antelope and wild turkey have been reintroduced.

The relatively few lakes in Hooker County total about 200 acres. These lakes and the rivers support a number of kinds of fish, mainly catfish, bullhead, bass, perch, bluegill, carp, and crappy. Trout may be found in suitable waters along the streams.

The wildlife resources of the county, existing and potential, are important primarily for the recreational opportunities they provide. Many species of wildlife in the county are also beneficial in control of rodents and undesirable insects.

The combination of soils, topography, climate, and vegetation in this county provides opportunity for developing facilities for outdoor recreation. Likely these

[4] By CHARLES V. BOHART, biologist, Soil Conservation Service.

Figure 16.—**The Dismal River canyon furnishes food and cover for wildlife.**

facilities would be oriented mainly toward use of the fish and wildlife resources. Nevertheless, increased travel by the American public provides other opportunities for using suitable soils for recreational purposes. Some soil areas are suitable as sites for camp grounds or picnic grounds, which would be a real convenience to travelers, and could be a source of supplemental income for landowners.

Opportunities for combining recreational enterprises with regular ranch operations might well be explored. Many people are interested in typical ranch operations and perhaps would appreciate an opportunity to learn about and take part in the day-to-day activities on a ranch. Such a combination of ranching and recreational enterprises might be especially valuable to ranchers whose opportunities may be limited by the size of their operating unit.

Since most of Hooker County is still grassland, it has retained a considerable part of the original potential for wildlife production. Some of the areas, particularly those bordering marshes and lakes, can be used primarily for production of wildlife. To lesser extent, this also applies to areas along the Dismal and Loup Rivers. Other lands must produce wildlife as a secondary crop, because a higher priority is placed on production of hay, grass, and cattle.

Where production of wildlife can be the first choice, a number of practices can be used to maintain and improve wildlife habitats. Streambanks can be protected from erosion by plantings, and access of livestock can be controlled. At the headwaters of streams, where flow is small and the water is cold, stream-improvement devices can be installed to provide better conditions for trout.

Deflectors often can be constructed in streams to create pools where water temperature is lower and more desirable for fish. Deflectors can also be constructed to scour sand and silt from gravel beds in streams. Beds of gravel produce better natural fish foods than beds of sand or silt and are essential for trout spawning.

Marsh areas overgrown with aquatic or semiaquatic vegetation can be improved for waterfowl by chemical and mechanical treatments that create areas of open water in the marshes.

On rangeland, where wildlife is necessarily a secondary crop, good range management, including proper use of the grasses, is important not only to production of forage for cattle, but also to production of wildlife. Seeding of clover in wet meadows is important if a suitable habitat for grouse is to be provided. Plantings of adapted trees, especially conifers, are valuable not only as winter protection for livestock, but also for the cover they furnish for a number of birds and animals.

Some oxbows and river bends in low-lying areas can be ditched and diked to form areas of water suitable for fish, waterfowl, and furbearers.

TABLE 6.—*Potential of soil associations for producing habitats for more important wildlife* [1]

Soil association	Wildlife	Potential for producing, for species of wildlife named—			
		Woody cover	Herbaceous cover	Food	Aquatic environment
Valentine, rolling-Anselmo.	Sharptail grouse	Good	Very good	Fair	
	Prairie chicken	Good	Very good	Good	
	Antelope		Good	Fair	
	Deer	Good	Very good	Fair	
Valentine, hilly-Dunday.	Sharptail grouse	Good	Very good	Good	
	Prairie chicken	Good	Very good	Good	
	Pheasant	Fair	Good	Fair	
	Antelope		Good	Good	
	Deer	Good	Very good	Fair	
Valentine, hilly.	Sharptail grouse	Good	Very good	Very good	
	Deer	Good	Very good	Good	
	Turkey	Fair	Fair	Fair	
Valentine, rolling.	Sharptail grouse	Good	Very good	Good	
	Prairie chicken	Good	Very good	Fair	
	Deer	Good	Very good	Fair	
	Antelope		Good	Fair	
Elsmere-Dunday-Valentine.	Deer	Good	Very good	Fair	
	Furbearers	Good	Good	Good	Good.
	Waterfowl				Good.
	Fish				Good.
Valentine-Loup.	Sharptail grouse	Good	Good	Good	
	Prairie chicken	Good	Good	Fair	
	Sharptail grouse	Very good	Fair	Good	
	Prairie chicken	Very good	Fair	Very good	
	Pheasant	Good	Good	Fair	
	Deer	Very good	Very good	Very good	
	Turkey	Fair	Fair	Fair	
	Furbearers	Good	Good	Good	Good.
	Waterfowl				Fair.
	Fish				Good.

[1] Development of specific habitat for wildlife requires proper location and distribution of the kind of vegetation that the soils can produce. Technical assistance in planning wildlife developments and determining which species of the vegetation to use can be obtained at the District Office of the Soil Conservation Service. Additional information and assistance can be obtained from the Nebraska Game, Forestation and Parks Commission, Bureau of Sports Fisheries and Wildlife, and from the Extension Service.

Interpreting Soil Properties for Engineering [5]

Some properties of soils are of special interest to engineers because they affect construction and maintenance of roads, airports, pipelines, foundations, and facilities for storing water, controlling soil erosion, draining soils, and disposing of sewage. In this section the properties of soils that most affect engineering are interpreted. Engineers can use these interpretations to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of the soils that will help in planning and designing structures and measures for soil and water conservation.
3. Make preliminary evaluations of soil and ground conditions that will help in selecting locations for highways and airports and in planning detailed investigations of the selected locations.
4. Estimate drainage areas and runoff characteristics for culvert and bridge design.
5. Classify soils along a proposed highway route and use this information in making preliminary estimates of required thickness for flexible pavement.
6. Estimate the need for clay to stabilize the surfacing on roads that are not paved.
7. Locate deposits of sand, gravel, rock, mineral filler, and soil binder for use in constructing subbase courses, base courses and surface courses for flexible pavements for highways and structures.
8. Make preliminary evaluations of terrain, such as topography, surface drainage, subsurface drainage, and height of water table, that need to be considered in designing highway embankments, subgrades, and pavements.
9. Correlate performance of engineering measures and structures with types of soil, and thus develop information that will be useful in designing and maintaining these measures and structures.
10. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.

[5] Prepared by LEE E. SMEDLEY, assistant State conservation engineer, Soil Conservation Service, with the assistance of WILLIAM J. RAMSEY, senior geologist, Division of Materials and Tests, Nebraska Department of Roads.

11. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that can be readily used by engineers.
12. Develop other preliminary estimates for construction purposes pertinent to the area.

The interpretations in this section will not eliminate the need for detailed field investigations before designing and constructing specific engineering works. The interpretations should be used primarily in planning detailed field investigations to determine the condition of the soil material in place at the proposed site.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words, for example, soil, clay, silt, sand, and aggregate, have special meaning in soil science. These and other terms are defined in the Glossary.

To make the best use of the soil maps and the soil survey reports, the engineer should know the physical properties of the soil materials and the in-place condition of the soil. After testing the soil materials and observing the behavior of each soil when used in engineering structures and foundations, the engineer can develop recommendations for each soil unit delineated on the map.

Engineering classification systems

Two systems of classifying soils are in general use among engineers. Both are used in this report. It is assumed that any persons using this report will be familiar with these systems or will have available reference material on these two classification systems.

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, which is made up of clay soils having low strength when wet. Within each group, the relative engineering value of the material is indicated by a group index number. The group index for the soil groups A–1, A–2, and A–3 is 0. For the poorest soils in group A–4, the group index is 8; in group A–5, the poorest soils have a group index of 12; in group A–6, the poorest soils have a group index of 16; and in group A–7, the poorest soils have a group index of 20. In table 7, the group index number is shown in parentheses, after the soil group symbol.

Some engineers prefer to use the Unified Soil Classification System (*9*). This system is based on identification of soils according to their texture and plasticity, and the soils are grouped according to their performance as engineering construction materials. The system establishes 15 soil groups. The soil materials are identified as coarse-grained soils (eight classes), fine-grained soils (six classes) and highly organic (one class). Boundary classifications are provided for soils that have characteristics of two groups. The system provides both a simple field method and a laboratory method to determine the amount and type of basic constituents of the soils. Both methods are based on gradation and plasticity and vary only in degree of accuracy. The laboratory method uses mechanical analyses, liquid limit data, and plasticity indexes for exact classification. A plasticity chart on which the liquid limit and the plasticity index may be plotted is used for a more accurate classification of the fine-grained soils. Classification of the tested soils according to the Unified system is given in table 7.

Engineering test data

Table 7 shows engineering test data for samples of two different soils from four sites. The samples were obtained during soil surveys made for highway projects located in the county. The testing, by the Division of Materials and Tests, Nebraska Department of Roads, was done in accordance with standard procedures of the American Association of State Highway Officials. Each soil was sampled by natural horizons. The terminology used by the Nebraska Department of Roads in describing each horizon differs somewhat from that used by the Soil Conservation Service. The Soil Conservation Service designates horizons as A, B, and C. The Department of Roads describes the horizons as the upper layer, middle layer, and the lower layer, or parent material. The "upper" layer is approximately equivalent to the A horizon; "middle;" to the B horizon; and "lower;" to the C horizon. Further explanation of the horizon designations generally used by soil scientists can be found in the Glossary of this report.

The test data in table 7 are for samples of Elsmere loamy fine sand from one location and of Valentine fine sand from three locations. In evaluating these data, it must be recognized that these soils vary according to location and that the data may not show the maximum range in characteristics that may be encountered.

The relation of moisture content of the soil material to density that can be achieved by compaction is very significant for many soils, but considerably less significant for the sandy soils of this county.

Tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of clayey soil increases from a very dry state, the material changes from a solid to a semisolid, or plastic, state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the material passes from a solid to a plastic state. Shown in table 7 are the *liquid limit*, which is the moisture content at which the material passes from a plastic to a liquid state, and the *plasticity index*, which is the numerical difference between the liquid limit and the plastic limit. The plasticity index indicates the range of moisture content within which a soil material is in a plastic condition.

The mechanical analyses of the soils shown in table 7 were made to determine the distribution of the particles of different sizes. These figures show that only a very small percentage of the material consists of particles less than 0.005 millimeter in size. As a result, the sandy, granular, noncohesive soils of this county are reported as nonplastic because they will not become plastic at any moisture content.

Additional detailed information on the soils of Hooker County is shown under the section "Descriptions of the Soils."

TABLE 7.—*Engineering test data*

[Tests performed by Division of Materials and Tests, Nebraska Department of Roads, in accordance

Soil and location	Parent material	Nebr. Dept. Roads sample No.	Depth of sampling	Horizon
Elsmere loamy fine sand:				
2,850 feet west on highway No. 2 from east section line of section 19, T. 24 N., R. 35 W.; then 40 feet south of highway.	Eolian sand	S 54–4529	0– 2. 0	Upper layer
Valentine fine sand, hilly:				
3,300 feet northwest on highway No. 97 from the south section line of section 14, T. 21 N., R. 32 W.; then 100 feet west of highway.	Eolian sand	S 59–5301 S 59–5328	0– 0. 6 0. 6–14. 0	Upper layer Lower layer
Valentine fine sand, rolling:				
70 feet southeast on highway No. 97 from the west section line of section 10, T. 21 N., R. 32 W.; then 50 feet east of highway.	Eolian sand	S 59–5305 S 59–5331	0– 1. 0 1. 0–19. 0	Upper layer Lower layer
2,195 feet southeast on highway No. 97 from north section line of section 4, T. 21 N., R. 32 W.	Eolian sand	S 59–5308 S 59–5335 S 59–5336	0– 0. 8 0. 8– 9. 0 9. 0–19. 0	Upper layer Parent material Parent material

[1] Mechanical analyses according to American Association of State Highway Officials Designation T 88 (*1*). Results of this procedure frequently differ somewhat from results that would be obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all material, including that coarser than 2 mm. in diameter. In the SCS soil survey procedure the fine material is analyzed by the pipette method and the material coarser than 2 mm. in diameter is excluded from the calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils. The percentages of particles 0.02 mm. and 0.002 mm. in size are not determined by the Nebraska Department of Roads.

Brief description of soils and their estimated physical properties

Engineering test data shown in table 7, together with information collected on the soil survey and experience with the same or similar soils from other counties upon which detailed test data were available, were used to describe the soils as shown in table 8.

The significance of some of the properties reported in table 8 are explained as follows.

Permeability refers to the rate at which water moves through the soil material in its undisturbed state. The rate depends largely on texture and structure of the soil. The permeability ratings used in this report and their equivalents in words are shown as follows:

Inches per hour	*Rating*
0.05 to 0.2	Slow.
0.2 to 0.8	Moderately slow.
0.8 to 2.5	Moderate.
2.5 to 5.0	Moderately rapid.
5.0 to 10.0	Rapid.
Over 10.0	Very rapid.

Available water capacity, measured in inches of water per inch of soil, is the water available for plant consumption. It is the water held in a soil between field capacity and permanent wilting point.

Reaction of a soil, its acidity or alkalinity, is reported in terms of pH values. A soil with a pH of 7.0 is neutral; one with a lower pH is acid, and one with a higher pH is alkaline. In this county, the reaction of the soils varies from slightly acid (pH 6.4) to moderately alkaline (pH 8.4). Surface soils are quite uniformly in the neutral range (pH 6.6 to 7.3).

All the soils of this county are quite similar in certain properties not listed in table 8. These are briefly described as follows:

Shrink-swell potential is an indication of the volume change to be expected with a change in moisture content. It is estimated on the basis of the amount and type of clay. The shrink-swell potential of all soils in this county, which in general are low in fines and nonplastic, is low. In general, shrinking and swelling is not a problem.

Surface runoff is slow, because the soils are predominantly sandy and infiltration of water is rapid. In a majority of cases, infiltration is so rapid that no runoff is produced. One exception to this is rough broken land in the mapping unit Valentine soils and rough broken land, where runoff is rapid.

Ponding and flooding are not common in this county. Only Elsmere fine sand, Elsmere loamy fine sand, and Gannett sandy loam are subject to ponding. Water may stand on these soils in winter or early in spring. The Gannett sandy loam is the slowest to drain.

Loup fine sand and Loup loam occasionally may be flooded in spring when there are ice jams on the rivers.

Salinity is not a problem. Soils in this county have little or no salinity.

on samples from four soil profiles

with standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analyses[1]						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—				AASHO[3]	Unified[4]
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 50[2] (0.295 mm.)	No. 200 (0.74 mm.)	0.05 mm.	0.005 mm.				
100	100	99	14	7	4	Nonplastic	Nonplastic	A–2–4(0)	SM.
100	99	93	3	3	3	Nonplastic	Nonplastic	A–3(0)	SW.
100	99	94	2	2	1	Nonplastic	Nonplastic	A–3(0)	SW.
100	100	98	4	3	3	Nonplastic	Nonplastic	A–3(0)	SW.
100	100	95	2	2	2	Nonplastic	Nonplastic	A–3(0)	SW.
100	99	94	4	2	2	Nonplastic	Nonplastic	A–3(0)	SW.
100	99	96	3	2	2	Nonplastic	Nonplastic	A–3(0)	SW.
100	99	95	4	2	2	Nonplastic	Nonplastic	A–3(0)	SW.

[2] The Nebraska Department of Roads does not report the No. 60 sieve size; the No. 50 sieve size was therefore substituted.

[3] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1, ed. 7): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145–49.

[4] Based on the Unified Soil Classification System, Technical Memorandum No. 3–537, vol. 1, Waterways Experiment Station, Corps of Engineers, March 1953 (*9*).

Dispersion is not a common property of the soils in this county, as soils are almost exclusively coarse grained, and the clay and silt fractions are predominantly low.

Engineering interpretations

Table 9 shows the suitability of the soils as sources of material for topsoil, sand, and road fill, and their suitability as a road subgrade.

Many of the soils in Hooker County are rated poor or fair as a source of topsoil because they are sandy, low in organic matter or natural fertility, or eroded. For the soils rated good as a possible source of fine sand, extensive exploration may be necessary to find material that will meet gradation requirements.

High quality sand-gravel is not readily available in Hooker County. However, limited quantities of poorly graded gravel may be found in the substratum of the Loup soils along the Loup River.

The suitability of soils as road fill material is based upon compacted weights, stability, workability, and other soil characteristics. Since sand is one of the better road fill materials, soils with an AASHO classification of A–1, A–2, or A–3 were rated as good. Finer grained materials (silty) were rated as fair. The range in ratings shown for some soils indicates the variation in the soil material that can be expected.

The suitability of the soils as material for subgrade has been shown for pavement (bituminous and concrete) and for gravel surfacing.

Since sand is the best subgrade material for bituminous and concrete pavement, the ratings were determined on the same basis as that used to obtain the ratings for soil material used as road fill. Since there are no truly clayey soils in Hooker County, the lowest rating for subgrade under bituminous and concrete pavement is fair. Because sand is noncohesive, it does not provide a stable base for gravel surfacing. Thus, all soil materials in classes A–3, and those materials in A–1 or A–2 that lack cohesiveness, rate as poor for subgrade for gravelled road. Some soils classed as A–1 or A–2 that have adequate cohesiveness, or plasticity, can be rated good to fair. Silty or clayey soils, which have an AASHO classification ranging from A–4 to A–7–6, are usually acceptable in that part of the upper subgrade that receives a gravel surfacing. Such soils are rated good to fair.

In table 9, under *features affecting highway location and agricultural drainage*, soil features are mentioned that might present problems during construction or affect maintenance costs after construction. Following are some comments on behavior of soils in the county when used for engineering.

Susceptibility to frost action.—Except for the Anselmo, Dunday-Anselmo, Dunday, and Gannett soils, the soils of Hooker County are not susceptible to frost action. Any of these four exceptions may have a surface layer containing sufficient fines (particles 0.02 millimeter or less in size) and a subsoil such that water may readily move upward through it by capillary action and thus present a minor problem.

TABLE 8.—*Brief description of the soils*

Map symbol	Soil name	Topography and position	Parent material	Depth to water table	Depth to Ogallala formation [1]	Depth from surface [2]
				Feet	*Feet*	*Inches*
Ao	Anselmo loamy fine sand, 0 to 1 percent slopes.	Nearly level upland valleys	Eolian silt and sand	10–20	7–15	0–13(8–16) 13–20(6–12) 20–48+
B	Blown-out land	Upland	Eolian sand	10–20	20+	0–48+
DA	Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes.	Nearly level upland valleys	Eolian silt and sand	10–20	7–15	0–48+
DuB	Dunday loamy fine sand, 2 to 5 percent slopes.	Slightly hummocky upland valleys.	Eolian sand and silt	10–20	10–20	0–19(12–21)
2DuB	Dunday loamy fine sand, terrace, 2 to 5 percent slopes.	Nearly level to slightly sloping river terraces.	Alluvial sand	5–10	5–20	0–36(24–42) 36–48+
DuB2	Dunday loamy fine sand, 2 to 5 percent slopes, eroded.	Slightly hummocky upland valleys.	Eolian sand and silt	10–20	10–20	19–72+
Ea	Elsmere loamy fine sand	Nearly level broad basins or narrow valleys.	Eolian sand	3–5	7–20	0–24
Eb	Elsmere fine sand	Nearly level broad basins or narrow valleys.	Eolian sand	3–5	7–20	0–48+
Gn	Gannett sandy loam	Nearly level upland basins or valleys.	Eolian sand	0–3	7–20	0–12(8–16) 12–34(10–34) 34–46+
Ld	Loup fine sand	Nearly level river bottoms	Alluvial sand and gravel.	1–2	20+	0–8(4–10) 8–48+
Lm	Loup loam	Nearly level river bottoms	Alluvial sand and gravel.	1–2	20+	0–8(8–12) 8–48+
VaC	Valentine fine sand, rolling	Smooth, rolling uplands	Eolian sand	(5)	20+	0–12(6–12) 12–228
VaD	Valentine fine sand, hilly	Choppy, hilly uplands	Eolian sand	(5)	20+	0–7(3–7) 7–168
VcB2	Valentine loamy sand, hummocky, eroded.	Hummocky upland valleys	Eolian sand and silt.	(5)	7–20	0–48+
VR	Valentine soils and rough broken land.	Upland canyons	Eolian sand	Mixed characteristics (steep slopes		

[1] Variation in depth, as shown, is considered normal for this county.

[2] Typical depth in this county shown by figures not in parentheses; figures in parentheses show variation in thickness of layer that may be expected.

Winter grading.—The adaptability of a given soil for winter grading varies from year to year, depending on the amount of moisture in the soil and the temperatures that occur during winter. If content of moisture and temperatures are both low, winter grading is permissible, since there can be no frost without moisture. If moisture content is low, and temperatures are high enough, moisture can be added to obtain suitable conditions for grading and compaction. But in winters when temperatures are low and content of moisture is high, freezing takes place and either stops grading, earth movement, and compaction or makes these difficult to perform.

Generally, coarse-grained soils that contain only small amounts of silt and clay, as found in Hooker County, are best suited to winter grading. However, winter grading of sandy soils should be allowed only if the required standards for compaction are met.

Agricultural drainage.—Surface conditions and permeability were considered in preparing this column in table 9. Permeability ratings shown were based on the classification shown on page 24, under the heading "Permeability." The Elsmere, Gannett, and Loup soils can be improved by drainage.

Irrigation.—Soils of this county, for the most part, are too sandy, steep, or wet for irrigation. Some sprinkler irrigation is practiced on the Anselmo and Dunday soils in growing alfalfa hay. These soils take in water at a moderate to rapid rate and generally are low in capacity to hold water available for plants. In most places, the hummocky topography makes gravity irrigation impractical. Soils that take in 2 inches or more of water per

and their estimated physical properties

USDA texture	Classification		Percentage passing sieve—			Permeability	Available water capacity	Reaction
	Unified	AASHO	No. 4	No. 10	No. 200			
						Inches per hour	*Inches per inch of soil*	*pH value*
Loamy fine sand	SM	A–2–4	100	100	20–30	2. 5–5	0. 10	6. 6–6. 8
Sandy loam	SM	A–2–4 or A–4	100	100	30–40	2. 5–5	0. 15	6. 8–7. 0
Fine to very fine sandy loam	SM	A–2–4 or A–4	100	100	30–45	2. 5–5	0. 15	7. 2–7. 8
Fine sand	SW or SW–SM	A–3	100	100	0–10	5–10	0. 06	6. 6–6. 8
Loamy fine sand	SM [3]	A–2–4	100	100	25–35	5–10	0. 10	6. 4–8. 4
Loamy fine sand	SM	A–2–4	100	100	20–30	5–10	0. 10	6. 5–6. 8
Loamy sand to loamy fine sand	SW, SW–SM, or SM.[4]	A–3 or A–2–4	100	100	1–15	5–10	0. 10	6. 7–7. 0
Fine sand	SW or SW–SM	A–3	100	100–95	0–10	5–10	0. 06	6. 8–8. 4
Loamy fine sand	SW or SW–SM	A–3	100	100	1–10	5–10	0. 10–0. 06	6. 6–7. 0
Loamy fine sand	SM	A–2–4	100	100	14	5–10	0. 10	6. 8–8. 0
Fine sand	SW or SW–SM	A–3	100	100	1–10	5–10	0. 10	7. 2–8. 4
Sandy loam	SM	A–2–4 or A–4	100	100	30–40	2. 5–5	0. 15	6. 4–6. 6
Silty clay loam	ML or CL	A–4	100	100	60–80	0. 2–0. 8	0. 18	6. 6–8. 0
Fine sand	SW or SW–SM	A–3	100	100	0–10	5–10	0. 10	8. 0–8. 4
Fine sand	SW or SW–SM	A–3	100	100	0–10	5–10	0. 10	7. 2–8. 0
Fine sand	SW or SW–SM	A–3	100	100–95	0–10	10+	0. 06	
Loam	SM, ML, or CL	A–4	100	100	50–60	0. 8–2. 5	0. 17	6. 8–7. 2
Fine sand	SW or SW–SM	A–3	100	100–95	0–10	10+	0. 06	6. 8–7. 6
Fine sand	SW	A–3	100	100	4	5–10	0. 06	6. 5–6. 8
Fine sand	SW	A–3	100	100	2	5–10	0. 06	6. 6–7. 0
Fine sand	SW	A–3	100	100	3	5–10	0. 06	6. 5–6. 8
Fine sand	SW	A–3	100	100	2	5–10	0. 06	6. 6–7. 0
Loamy fine sand or fine sand in Ogallala formation or very thin soil (Valentine) on fine eolian sand).	SW, SW–SM, or SM.	A–3 or A–2–4	100	100	4–15	5–10	0. 06	6. 5–7. 0

[3] Below the surface layer the amount of fines varies in this complex; a range from SM to SW can be expected.

[4] In some areas the amount of fines in the surface layer varies because fines washed from higher lands have been deposited on the soil.

[5] Water table at depth too great to be significant in engineering interpretations.

hour are considered to have rapid intake of moisture, and those that take less than half an inch per hour, a slow intake rate. A soil rated as low in capacity to hold water is one that holds 3 to 5 inches of water in the top 4 feet of its profile.

Further information on suitability of soils for irrigation can be obtained from the Irrigation Guide for Central and Eastern Nebraska.

Low dams and structures.—Currently, there appears to be no need for low dams in the county. If used, provision would have to be made to avoid piping, and to seal the reservoir area if water were to be stored.

The bearing capacity of soils at depths below 30 inches is quite uniformly good. The Anselmo, Dunday-Anselmo, Dunday, Gannett, and Loup soils, because of their higher silt content at depths of less than 48 inches, would be rated fair to poor. A moderate piping hazard would be expected in these soils.

The soils of this county are, in general, good embankment materials. They have fair to high stability, and all except the silty sands are pervious. Embankments may require slope protection and foundation drains.

Dikes and levees.—Because of position, topography, and absence of flooding, dikes and levees generally are not needed or applicable. However, should low levees or dikes be built, many of the silty sands would pose problems in piping and slope erosion.

Terraces and diversions.—The topography and soils of this county are generally unsuitable for terraces and diversions, and ordinarily these are not needed.

TABLE 9.—*Engineering*

[For general comment on suitability of soils for foundations, dikes, levees,

Soil series and map symbols	Engineering classification		Suitability as source of—	
	Unified	AASHO	Topsoil	Sand [1]
Anselmo (Ao)	SM	A–2–4 over A–2–4 or A–4	Fair to poor.	Good to poor.
Blown-out land (B)	SW or SW–SM	A–3	Poor	Good
Dunday-Anselmo (DA)	SM	A–2–4	Fair	Good to fair.
Dunday (DuB, 2DuB, DuB2)	SW, SW–SM, or SM over SW or SW–SM.	A–3 or A–2–4 over A–3	Fair to poor.	Good to fair.
Elsmere (Ea, Eb)	SW, SW–SM, or SM	A–3 or A–2–4	Fair to poor.	Good to fair.
Gannett (Gn)	SM over ML or CL, over either SW or SW–SM.	A–2–4 or A–4 over A–4, over A–3	Good to fair.	Fair to poor.
Loup: Fine sand (Ld)	SW or SW–SM	A–3	Poor	Good to fair.
Loam (Lm)	SM, ML, or CL over either SW or SW–SM.	A–4 over A–3	Good	Good to fair.
Valentine (VaC, VaD, VcB2)	SW, SW–SM, or SM	A–3 or A–2–4	Poor	Good
Valentine soils and rough broken land (VR).	Mixed characteristics			

[1] Rating based on availability of fine sand (0.4 to 0.074 millimeter).

Waterways.—The topography and land use in this county are such that waterways generally are not needed.

Wind erosion.—All the soils of Hooker County are susceptible to wind erosion where vegetative cover is not maintained.

Descriptions of the Soils

Hooker County is part of a vast sandy grassland marked by small and large dunes and intervening small swales and rather large, level valleys (fig. 17). The only steep, broken land is that along the rivers.

All the soils in the county developed in sands deposited by wind or water. Some of them, especially those in valleys in the eastern part of the county, or along the Dismal and Middle Loup Rivers, have been somewhat influenced by silts washed or blown from the Ogallala formation. This is a soft, silty sandstone of Tertiary age that is exposed along the rivers. This sandstone underlies all of the county, but in the eastern part it is exposed or is only a few feet below the surface in the upland valleys.

Most of the soils of this county are sandy and not suited to cultivation. Less than 6 percent of the acreage in the county has ever been plowed, and much of this has been returned to native grass, which provides grazing for beef cattle.

In this section each soil series and all the mapping units in Hooker County are described. Each soil series is described, and then the mapping units of that series. A detailed typical soil profile is described for each series. It is to be assumed that all the mapping units of a given series have essentially the same kind of profile. The differences, if any, are apparent in the name of the mapping unit, or they are mentioned in the description of the unit.

Some explanation may be helpful to those who are not familiar with the methods and terms used in describing soil profiles.

When soil scientists write about a soil they designate each of its layers, or horizons, with a letter of the alphabet. The horizon at the surface, called the A horizon, is the layer in which maximum organic matter has accumulated, and the layer from which soluble minerals and clay generally have been removed by downward percolation of water. The A horizon is frequently divided, as for example, A1, A2, A3.

The B horizon, if one is present, is the layer in which clay minerals have accumulated. It may be divided, as for example, B1, B2, B3.

interpretations

low dams, irrigation systems, terraces, and diversion ditches, see text, pp. 26 to 27]

Suitability as—			Features affecting—	
Road fill	Road subgrade		Highway location	Agricultural drainage
	Paved	Gravelled		
Good to fair.	Good to fair.	Poor to fair.	Slightly susceptible to frost action; may require slope protection.	Rapidly permeable; drainage not needed.
Good-----	Good----	Poor-----	May require slope protection----------	Rapidly permeable; drainage not needed.
Good-----	Good----	Poor-----	May require slope protection; subject to seasonal high water table; slightly susceptible to frost action.	Rapidly permeable; drainage not needed.
Good-----	Good----	Poor-----	May require slope protection; slightly susceptible to frost action; subject to high water table.	Rapidly permeable; drainage not needed.
Good-----	Good----	Poor-----	Subject to high water table and ponding; may require slope protection.	Seasonal high water table beneficial to grasses; surface drainage needed for cultivation.
Good to fair.	Good to fair.	Fair to poor.	Slightly susceptible to frost action; subject to high water table and ponding; may require slope protection.	Surface drainage needed to prevent ponding in hay meadows; moderately to rapidly permeable in upper 3 feet; rapidly permeable below 3 feet.
Good-----	Good----	Poor-----	Subject to high water table and flooding; may require slope protection.	Drainage would be beneficial to grasses; outlet for drainage works difficult to obtain.
Good to fair.	Good to fair.	Fair to poor.	Subject to high water table and flooding; may require slope protection.	High water table beneficial to grasses; water table near water level in river; moderately rapid permeability in surface layer.
Good-----	Good----	Poor-----	May require slope protection----------	Rapidly permeable; drainage not needed.
----------	----------	----------	----------	Rapidly permeable; extremely steep slopes; drainage not needed.

The C horizon is material under the true soil (A and B horizons) that appears to be somewhat the same as that from which the overlying layers formed. Thus, the C horizon designates parent material.

The D horizon is underlying material that appears to be different from the material in the horizons above it. In some instances it is hard rock.

The soils in Hooker County do not have distinguishable B horizons. Many have a transitional horizon between the A and C horizons, and this horizon is designated by the symbol AC.

The boundaries between soil horizons differ in shape and distinctness. The terms used to describe shape are *smooth*, *wavy*, *irregular*, or *broken*, and those for distinctness, are *clear*, *gradual*, or *diffuse*.

The color of the material in a soil horizon is described both in words and in Munsell notations; for example, "dark gray (10YR 4/1)." The Munsell notations indicate color more precisely than words and thus allow scientists to make more accurate comparisons among soils.

Texture is the relative proportions of the mineral grains of different sizes (sand, silt, and clay) that make up a soil mass. Particles designated as sands are coarsest, and those called clays are finest. The texture of a soil significantly affects its behavior. A sandy soil, for example, is easily worked when wet or dry, but a clayey soil is ordinarily hard when dry and sticky and plastic when wet.

Structure refers to the arrangement of soil grains in lumps, granules, or other natural aggregates. The structure of a soil horizon is described in terms that indicate strength, or grade of the aggregates (*weak*, *moderate*, or *strong*); their size (*very fine*, *fine*, *medium*, *coarse*, or *very coarse*), and their shape (*platy*, *prismatic*, *columnar*, *blocky*, *subangular blocky*, *granular*, or *crumb*). Soils without definite structure are described as *single grain* if they are sands, or *masssive* if they are clays.

Consistence, or the resistance of soil material to deformation under pressure, can be reported for soils when they are wet, moist, or dry. In this survey, consistence is reported mostly for the soils when moist and dry; for example, "soft when dry, very friable when moist."

In this report, soil layers are described as "calcareous" or "noncalcareous". Those that are calcareous react, or fizz, when dilute hydrochloric acid is applied. This reaction shows presence of free lime. Availability of lime affects use of soils for crops, particularly crops such as alfalfa.

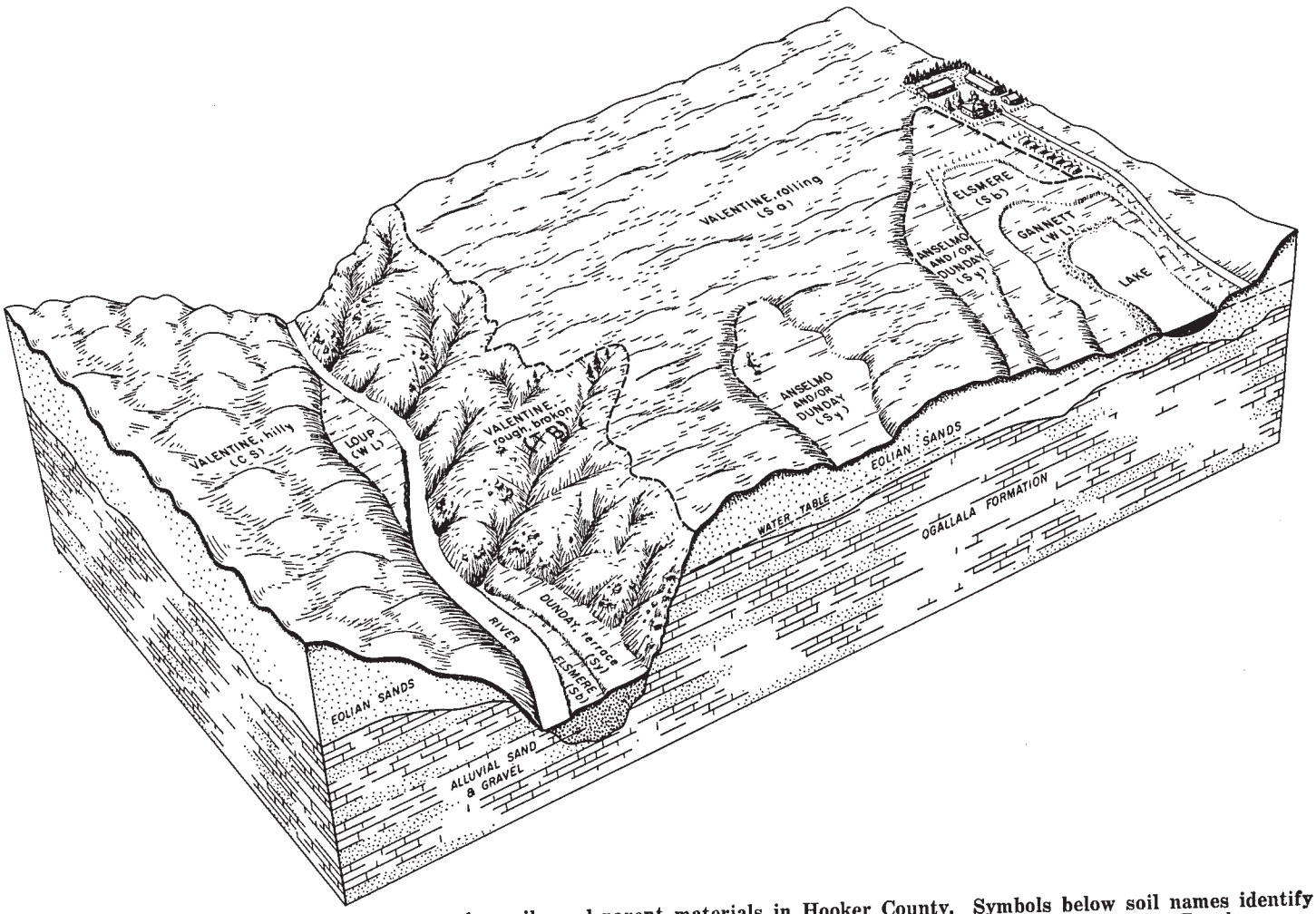


Figure 17.—**Diagram showing typical topography, soils, and parent materials in Hooker County. Symbols below soil names identify range sites, as follows:** CS=**Choppy Sands;** WL=**Wet Land;** Sb=**Subirrigated;** Sv=**Sandy;** So=**Sands; and** TB=**Thin Breaks.**

The acreage and proportionate extent of the mapping units in this county are shown in table 10. The location of the individual areas of each mapping unit is shown on the detailed map at the back of this report. This map has been prepared in detail sufficient for ranch planning, or the grassland type of agriculture now practiced in the county. The mapping in areas cultivated or suitable for cultivation is somewhat more detailed than elsewhere.

Any given area of a specified mapping unit may include small areas of other kinds of soil. These small areas, called inclusions, are mentioned in the description of the mapping unit. Areas of blowout, or of some other soil condition, that occupy less than 5 acres are shown on the soil map by special symbols, which are explained in the legend for the map.

TABLE 10.—*Approximate acreage and proportionate extent of soils*

Soil	Acres	Percent
Anselmo loamy fine sand, 0 to 1 percent slopes	496	0.1
Blown-out land	2,815	.6
Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes	3,573	.8
Dunday loamy fine sand, 2 to 5 percent slopes	6,535	1.4
Dunday loamy fine sand, 2 to 5 percent slopes, eroded	5,680	1.2
Dunday loamy fine sand, terrace, 2 to 5 percent slopes	255	(1)
Elsmere fine sand	241	(1)
Elsmere loamy fine sand	1,796	.4
Gannett sandy loam	726	.2
Loup fine sand	805	.2
Loup loam	150	(1)
Valentine fine sand, hilly	37,762	8.2
Valentine fine sand, rolling	391,847	84.8
Valentine loamy sand, hummocky, eroded	455	.1
Valentine soils and rough broken land	8,581	1.9
Lakes	205	(1)
Marsh	158	(1)
Total	462,080	100.0

[1] Less than 0.1 percent.

Anselmo Series

The Anselmo series consists of deep, moderately sandy to sandy soils in nearly level to gently sloping enclosed valleys. These soils have a brown to very dark gray surface soil that is 12 to 14 inches thick except where it has been eroded by wind. The underlying material is fine

sand mixed with silt blown from the Ogallala formation, which lies a few feet below the valley floor.

The Anselmo soils developed in sandy loam, whereas the associated Dunday and Valentine soils developed in loamy sand or fine sand. The Anselmo soils are well drained. They developed under a good cover of mid and tall grasses.

Typical profile of Anselmo loamy fine sand under native sod (0.1 mile south of northeast corner of sec. 5, T. 23 N., R. 33 W.):

A11—0 to 7 inches, dark-gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) when moist; weak, coarse, blocky structure breaking to single grain; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A12—7 to 13 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, coarse, blocky structure breaking to single grain; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

AC—13 to 20 inches, grayish-brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C1—20 to 36 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, very friable when moist; gradual, smooth boundary.

C2—36 to 48 inches +, grayish-brown (10YR 5.5/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak prismatic structure breaking to weak, medium, subangular blocky; hard when dry, friable when moist; noncalcareous. (This may have been an Ab horizon.)

Anselmo soils are variable because of wind erosion. In many places the parent material is stratified silt and sand. Buried former surface layers are common. Anselmo soils are noncalcareous. They are fertile where they have never been cultivated, but in cultivated fields much of their fertility has been lost through cropping and wind erosion. Most areas of these soils have been mapped in complex with Dunday soils, or they are included with other mapping units.

Anselmo loamy fine sand, 0 to 1 percent slopes (Ao).—This is the only Anselmo soil mapped separately in the county. Its surface layer ranges from a loamy fine sand in the winnowed spots to a very fine sandy loam in the small depressions. The soil is suited to any of the crops adapted to the area, but some care is required to control wind erosion and to maintain fertility. (Capability unit IIIe–5; Sandy range site.)

Blown-out Land

Blown-out land (B) is a land type resulting from complete destruction of any sandy soil by wind erosion.

The blowouts are caused mainly by excess trampling around watering places and by including abandoned cultivated fields in summer pastures. They are areas of loose blowing sand on which there is little or no permanent vegetation.

Only bare shifting areas of sand that produce no appreciable feed for livestock are mapped as Blown-out land. These areas of unstable sand were not assigned to a range site. Whenever they are stabilized, however, they can be managed like soils of the Sands range site. Former blowouts now stabilized with permanent vegetation are mapped as inclusions with Valentine fine sand, rolling, and are in capability class VIe–5.

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Dunday Series

In the Dunday series are deep, sandy soils that have a surface layer ranging from loamy fine sand to loamy sand in texture and from dark grayish brown to very dark brown in color. These soils are in the nearly level to gently sloping enclosed valleys and on river terraces. They have developed mainly in fine sand but have been influenced by some silty material blown or washed from the underlying Ogallala fine sandstone. They are noncalcareous. They formed under a good cover of mid and tall grasses.

Dunday soils have less silt in the lower part of their profile than the Anselmo soils, and their surface layer is darker and thicker than that of the associated Valentine soils (fig. 18). The Dunday soils are well drained, whereas the associated Elsmere and Gannett soils are imperfectly and poorly drained, respectively.

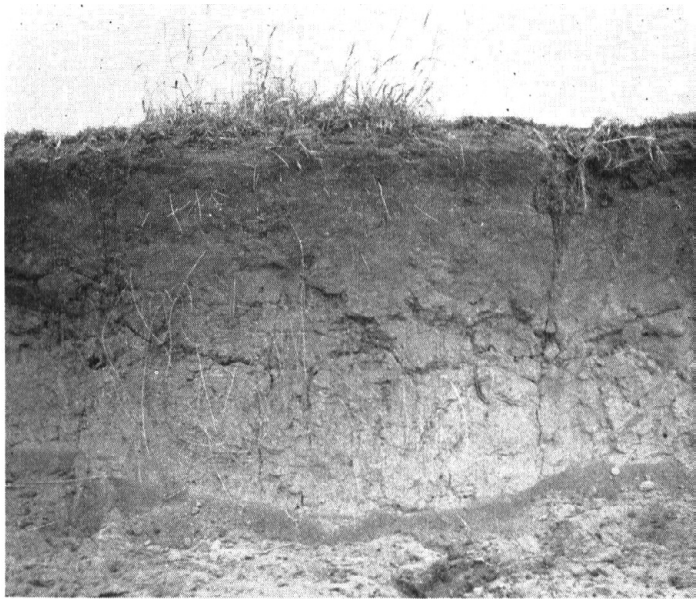

Figure 18.—**Profile of Dunday loamy fine sand, 2 to 5 percent slopes. The dark surface layer is about 12 inches thick.**

Typical profile of Dunday loamy fine sand under native sod (200 feet north of center of sec. 8, T. 23 N., R. 32 W.):

A11—0 to 10 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) when moist; weak, coarse, prismatic structure breaking to single grain; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

A12—10 to 19 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to single grain; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

AC—19 to 30 inches, dark grayish-brown (10YR 4/2, moist) loamy fine sand; weak, coarse, prismatic structure breaking to single grain; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C—30 to 72 inches, light brownish-gray (10YR 6/2) loamy fine sand, brown (10YR 5/3) when moist; weak, coarse, prismatic structure breaking to single grain; soft when dry, very friable when moist; noncalcareous.

Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes (DA).—This mapping unit occurs in nearly level enclosed valleys and consists of about equal parts of Dunday and Anselmo soils and intergrades between soils of these two kinds. The surface layer ranges from 10 to 20 inches in thickness and most commonly is dark grayish brown.

Included within this mapping unit are some small areas of Dunday soil that has been eroded. In these places wind has done some shifting and sorting of soil particles.

The Dunday soil in this mapping unit has better water-holding capacity than other Dunday soils.

Most of this mapping unit has been cultivated. (Capability unit IVe–5; Sandy range site.)

Dunday loamy fine sand, 2 to 5 percent slopes, eroded (DuB2).—This soil occurs on the hummocky gentle slopes in the enclosed valleys that have been moderately eroded by wind. The shifting and sorting of the soil particles have resulted in wide variation in thickness, color, and texture of the surface layer.

A surface layer commonly is 8 to 12 inches thick, but in many of the included blown-out areas all of the original surface layer has been lost. In color, the surface layer ranges from very dark brown to dark grayish brown, and in texture, from loamy fine sand to fine sand.

Included with this soil in mapping are small areas of Anselmo loamy fine sand, 0 to 1 percent slopes; small areas of Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes, and some severely eroded spots.

All of this soil was farmed at one time. (Capability unit IVe–5; Sandy range site.)

Dunday loamy fine sand, 2 to 5 percent slopes (DuB).—This soil is on hummocky gentle slopes in the enclosed valleys. It varies considerably according to position. On the hummocks its surface layer is only 7 to 10 inches thick and dark grayish brown. Between hummocks, however, this layer is 10 to 20 inches thick and is dark grayish brown.

This soil includes small areas of Valentine fine sand, rolling, which is on the larger hummocks.

Nearly all of this Dunday soil is still in native grass. (Capability unit IVe–5; Sandy range site.)

Dunday loamy fine sand, terrace, 2 to 5 percent slopes (2DuB).—This is a deep, well-drained soil on the stream terraces (fig. 19). It differs from the other Dunday soils mainly in type of parent material. Its parent material is mostly alluvial fine sand with some gravel. In some places, however, the alluvium has been mixed with eolian sands, and in others, some silts have been washed in from Tertiary material exposed along the river breaks.

Most of this soil has been severely winnowed by wind, and this has caused wide variation in thickness of the surface layer. On the average, the surface layer is between 4 and 8 inches of very dark grayish-brown to dark grayish-brown loamy fine sand or loamy sand.

This soil occurs in association with the imperfectly drained and poorly drained Elsmere and Loup soils of the bottom lands.

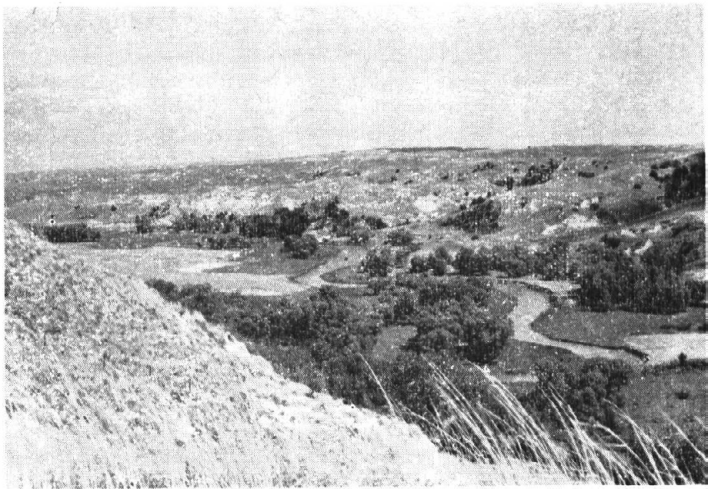

Figure 19.—Light-colored, nearly level areas just above the river are Dunday loamy fine sand, terrace, 2 to 5 percent slopes; dark-colored areas next to the river are poorly drained Loup soils.

Most of this soil is in alfalfa, which is sprinkler irrigated from the river. (Capability unit IVe–5; Sandy range site.)

Elsmere Series

The soils of the Elsmere series are deep, moderately sandy to very sandy, and imperfectly drained. Their water table is 30 to 60 inches from the surface most of the time, but it may be at or near the surface in spring. These soils occur in nearly level, enclosed upland valleys and along river valleys. They developed under a heavy growth of mid and tall grasses.

The surface soil ranges from grayish brown to very dark brown. In some places, the soils are calcareous at the surface.

Elsmere soils occur with the poorly drained Loup and Gannett soils and the well-drained Anselmo, Dunday, and Valentine soils.

Typical profile of Elsmere loamy fine sand under native sod (0.2 mile northeast of center of sec. 20, T. 23 N., R. 35 W.):

A0—1 inch to 0, partially decomposed leaves and stems.

A11—0 to 6 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to single grain; very friable when moist, slightly hard when dry; noncalcareous; clear, smooth boundary.

A12—6 to 8 inches, very dark gray (10YR 3/1, moist) sandy loam; weak, coarse, prismatic structure breaking to weak, medium, granular; very friable when moist, slightly hard when dry; noncalcareous; clear, smooth boundary.

C—8 to 26 inches, brown (10YR 5/3) loamy sand, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to single grain; loose when moist, soft when dry; calcareous; clear, smooth boundary.

Ab—26 to 36 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; very friable when moist; noncalcareous; clear, smooth boundary.

Cb—36 to 48 inches, very pale brown (10YR 7/3) fine sand, light brownish gray (10YR 6/2) when moist; single grain (structureless); loose when moist; noncalcareous; water table at depth of 42 inches.

Elsmere loamy fine sand (Ea).—The surface layer of this soil commonly is very dark grayish brown in color and loamy fine sand in texture. In some areas, however, this layer is very fine sandy loam to sandy loam. The thickness of the surface layer ranges from 8 to 20 inches. Former surface layers, now buried, are common. Light-colored fine sand is 24 to 36 inches from the surface in most places.

This soil is used for range or hay meadow. (Capability unit IVw–5; Subirrigated range site.)

Elsmere fine sand (Eb).—This soil has a coarser, lighter colored, thinner surface layer than Elsmere loamy fine sand. The texture of this layer varies between loamy sand and fine sand, and the color, between very dark grayish brown and dark grayish brown. The extreme range in thickness of the surface layer is 3 to 14 inches, but the more common range is from 7 to 12 inches.

This soil is not suited to cultivation. (Capability unit VIw–5; Subirrigated range site.)

Gannett Series

In the Gannett series are deep, dark soils of the poorly drained depressions. These soils developed from sand under the influence of excess water and large amounts of organic matter from decaying vegetation.

The A horizon, or surface layer, of these soils is 12 to 36 inches or more in thickness. It is very dark grayish brown to black, and it contains gleyed zones where gray colors are more evident. The texture ranges from loamy fine sand to silt loam, and the proportion of organic matter is very high. The lower part of the A horizon in some places contains more clay than the upper.

These soils are noncalcareous, or calcareous only in the upper few inches. The water table ranges from the surface to a depth of 30 inches. Water often covers the surface in winter and spring.

The Gannett soils are closely associated with the imperfectly drained Elsmere soils and the well-drained Dunday and Anselmo soils. They are not so coarse textured as the Loup soils and are gleyed.

Typical profile of Gannett sandy loam in upland depression under native sod (0.15 mile east and 0.3 mile north of center sec. 18, T. 24 N., R. 35 W.):

A0—2 inches to 0, organic matter (partially decomposed leaves and stems).

A11—0 to 3 inches, very dark gray (10YR 3/1, moist) sandy loam; weak, fine, granular structure; very friable when moist; calcareous; clear, smooth boundary.

A12—3 to 6 inches, very dark gray to black (10YR 2.5/1, moist) light loam; weak, fine, granular structure; very friable when moist; calcareous; abrupt, wavy boundary.

A3—6 to 8 inches, dark-gray (10YR 4/1, moist) fine sandy loam; weak, fine, granular structure; very friable when moist; noncalcareous; clear, smooth boundary.

A11b—8 to 14 inches, black (10YR 2/1, moist) fine sandy loam; weak, medium, blocky structure; friable when moist; noncalcareous; clear, smooth boundary.

A12b—14 to 22 inches, very dark gray (10YR 3/1, moist) silty clay loam; weak, medium, blocky structure; firm when moist; noncalcareous; a few iron stains along roots; clear, smooth boundary.

A13b—22 to 34 inches, very dark grayish-brown (2.5YR 3/2, moist) silty clay loam; weak, medium, blocky structure; firm when moist; noncalcareous; few, medium, and very fine mottles; water table at 30 to 32 inches; gradual, smooth boundary.

A14b—34 to 46 inches, gray to dark-gray (10YR 4.5/1, moist) fine sand; single grain (structureless); very friable when moist; noncalcareous.

Gannett sandy loam (Gn).—This is the only soil of the Gannett series mapped in the county. It occurs in wet upland depressions and is the wettest soil in the county.

Included with this soil are some areas of Elsmere loamy fine sand, Elsmere fine sand, and Marshland.

This soil is used as hay meadow or range. In most years, it is too wet for cultivation. (Capability unit Vw–1; Wet Land range site.)

Loup Series

In the Loup series are poorly drained soils in narrow areas on bottom lands along the Loup and Dismal Rivers.

The surface layer contains much organic matter, some of which is only partly decomposed. The texture of this layer ranges from silty clay loam to fine sand. In many places the lower part of the surface layer is darker and finer textured than the upper part. The alluvial material under the surface layer is fine to coarse sand and gravel.

Normally, soils of this series are calcareous only at or near the surface. The water table ordinarily is stable at a depth 12 to 24 inches from the surface.

The Loup soils occur with soils of the Elsmere series, which are better drained, and with the Dunday soils of the terraces. They are similar to the Gannett soil of the upland depressions but have developed in coarser textured sand and lack the gleying common in the Gannett soil.

Typical profile of Loup loam under native sod (along the Middle Loup River, 2,500 feet east of center of sec. 8, T. 24 N., R. 32 W.):

A11—0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A12—2 to 8 inches, gray (10YR 6/1) loam, very dark gray (10YR 3/1) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

AC—8 to 18 inches, light-gray (10YR 7/1) loamy fine sand, light brownish gray to grayish brown (10YR 5.5/2) when moist; weak, coarse, subangular blocky structure; very friable when moist; noncalcareous; abrupt, smooth boundary.

C1—18 to 24 inches, light-gray (10YR 7/2) very fine sand, gray (10YR 6/1) when moist; single grain (structureless); loose when dry or moist; many dead roots; few, fine, faint mottles mostly along old root channels; noncalcareous; water table at depth of 19 inches; many iron stains; abrupt, smooth boundary.

C2—24 inches, light-gray (10YR 7/1) sand and gravel (10YR 7/2, moist); single grain (structureless); soft when dry, loose when moist; noncalcareous.

Loup fine sand (Ld).—The surface layer of this soil is very dark gray to grayish brown when moist. Its texture ranges from loamy fine sand to fine sand. Normally, there is 1 to 4 inches of partially decomposed organic matter on top of the soil, and there are occasional darker layers of loam within the profile. The mineral surface soil ranges from 2 to 12 inches in thickness. The underlying alluvial material is fine sand to gravel.

Included with this soil are areas of Loup loam, of Elsmere loamy fine sand, and of Marshland.

This soil is too wet for cultivation. It is used for range or hay meadow. (Capability unit Vw–5; Wet Land range site.)

Loup loam (Lm).—This soil lies a few inches higher above the river than Loup fine sand. It is an older soil and shows more development of the surface layer. The surface layer is 4 to 12 inches of very dark grayish-brown to black fine sandy loam to clay loam. The underlying alluvial material ranges from fine sand to gravel.

Included with this soil are areas of Loup fine sand, some areas of Elsmêre loamy fine sand, and some areas of Marshland.

This soil is too wet for cultivation and is used for hay or range. (Capability unit Vw–1; Subirrigated range site.)

Marshland (Marsh)

Marshland, shown on the soil map by marsh symbol, is land too wet to support palatable grasses, rushes, or sedges. It is not classified as a soil, because the areas may be under open water during winter and spring but are partly closed over with a growth of cattails and other water-growing plants during summer. Areas of Marshland used for hay were mapped as inclusions within areas of Gannett sandy loam. Marshland is in class VIII and is suitable only as a wildlife habitat.

Valentine Series

In the Valentine series are deep, light-colored, very sandy soils on hummocks and dunes (fig. 20). They cover about 90 percent of the county. They are well-drained to excessively drained, noncalcareous soils that developed under a good plant cover consisting mostly of tall and mid grasses.

The surface layer is 3 to 10 inches thick, is brown to dark grayish brown when moist, and is a fine sand in texture. In eroded areas or areas recently stabilized there is little of this layer, or all of it has been destroyed. In some places the texture of the surface layer is loamy fine sand. The material underlying the surface layer is pale-brown to brown fine sand.

Except along the river breaks, areas of Valentine soils show little or no drainage pattern, because the water infiltrates rapidly and little is left to run off.

Typical profile of Valentine fine sand, rolling, under native sod (1,200 feet east and 1,400 feet south of northwest corner of sec. 2, T. 23 N., R. 33 W.):

A1—0 to 9 inches, grayish-brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) when moist; single grain (structureless); soft when dry, loose when moist; noncalcareous; gradual, smooth boundary.

AC—9 to 16 inches, light brownish-gray (10YR 6/2) fine sand, brown (10YR 5/3) when moist; single grain (structureless); soft when dry, loose when moist; noncalcareous; gradual, smooth boundary.

C—16 to 32 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; single grain (structureless); loose when dry or moist; noncalcareous.

Valentine fine sand, hilly (VaD).—This soil occurs on the larger and steeper dunes that were last to be stabilized. Many of them have been stabilized since the settlers began to control prairie fires that once destroyed protective vegetation.

Figure 20.—**Profile of a Valentine soil showing about 6 inches of surface soil.**

The surface layer is lighter colored than that of soils on the lower and smoother dunes, since the higher dunes were last to be stabilized. The surface layer is seldom more than 3 inches of brown fine sand, though this layer is somewhat deeper in the swales and on lower slopes. Slopes are generally more than 16 percent and are marked with many catsteps.

From 20 to 40 percent of the areas of this soil consists of included areas of Valentine fine sand, rolling, which is on the smoother slopes; and about 5 percent consists of Dunday loamy fine sand, 2 to 5 percent slopes, which is in the swales and narrow valleys.

This Valentine soil is used for range. (Capability unit VIIe–5; Choppy Sands range site.)

Valentine fine sand, rolling (VaC).—Nearly 85 percent of the county is occupied by this soil. It is on hummocks and lower and smoother dunes. Slopes generally range from 3 to 16 percent, but steeper slopes are included.

In most places the surface layer is 4 to 10 inches of dark grayish-brown loamy fine sand to fine sand. Adjacent to areas where the Ogallala formation has been exposed, there are a few areas where the texture of the surface layer is loamy fine sand.

In given areas of this soil, up to 50 percent of the acreage may consist of Valentine fine sand, hilly, which is on the steeper and rougher slopes. Also included are small areas of Valentine loamy sand, hummocky, eroded; Dunday loamy fine sand, 2 to 5 percent slopes; Dunday loamy fine sand, 2 to 5 percent slopes, eroded; Anselmo loamy fine sand, 0 to 1 percent slopes; Elsmere loamy fine sand; Elsmere fine sand; and Gannett sandy loam.

This soil is used for range or hay meadow. (Capability unit VIe–5; Sands range site.)

Valentine loamy sand, hummocky, eroded (VcB2).—This is land where Valentine, Dunday, and Anselmo soils have been so much altered by wind erosion that they can no longer be identified. It consists of blown-out areas, hummocks where soil material has accumulated, and some areas that have been little disturbed by wind. The blown-out areas are raw parent material; and hummocky areas are loose sand.

Winnowing has removed much of the organic matter and the fine soil particles from the surface layer.

This mixture of wind-eroded soils is not suitable for cultivation. (Capability unit VIe–5; Sands range site.)

Valentine soils and rough broken land (VR).—This mapping unit consists of Valentine soils and rough broken land along the Dismal and Loup Rivers (fig. 21). It contains Valentine fine sand, hilly; Valentine fine sand, rolling, and rough broken land. In some areas, alluvial soils along the river are included.

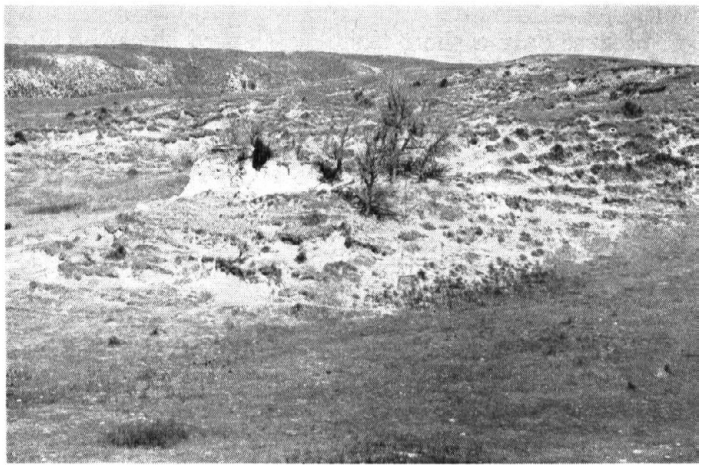

Figure 21.—**Rough broken topography and outcrops of Ogallala sandstone typical in areas of Valentine soils and rough broken land.**

The Valentine soils of this mapping unit are much like they are where mapped separately. Valentine fine sand, rolling, contains considerable loamy fine sand.

The rough broken land occurs where the Ogallala formation has been exposed by the cutting action of the rivers. This formation is a soft, white, fine-grained sandstone of Tertiary age. It weathers to a mixture of fine sand and silt. This weathered material has been mixed with eolian sands, and the result is shallow to deep soil-forming material of sandy loam to fine sand texture. Runoff waters have cut numerous V-shaped channels that are bordered by sharp divides. In most places, the surface layer on rough broken land is 2 to 3 inches of loamy fine sand that is dark grayish brown to grayish brown when moist.

This mapping unit is used for range. (Capability unit VIIs–3; Thin Breaks range site.)

Origin and Classification of Soils

Soils are formed through interaction of climate, living organisms, parent materials, topography, and time. The nature of a soil at any point on the earth depends on the combination of the five factors at that point. All five factors come into play in the genesis of every soil. The relative importance of each differs from place to place. In some places one is dominant, and in other places another. But it is the past interaction of the five major factors that is of first importance in determining the present nature of every soil. These five factors are next discussed as they relate to the soils of Hooker County.

Parent material.—Hooker County is in the west-central part of Nebraska, in the northern part of the High Plains section of the Great Plains province. It lies in the heart of the region known as the Sandhills of Nebraska.

Before Tertiary time, the part of the North American continent that now includes Hooker County was covered several different times by ocean waters in which were deposited a great thickness of sediments that eventually formed sandstone, shale, and limestone.

During the Tertiary age, outwash from the Rocky Mountains covered this area with a few to many feet of stratified silt and sand. This stratified material is the source of the Ogallala sandstone, which is now covered by eolian sands to depths ranging from a few feet in the valleys to 300 feet or more in the large dunes (fig. 22). The exact source of the eolian sand is not known. Locally, material from the Ogallala formation and the eolian sand have been mixed.

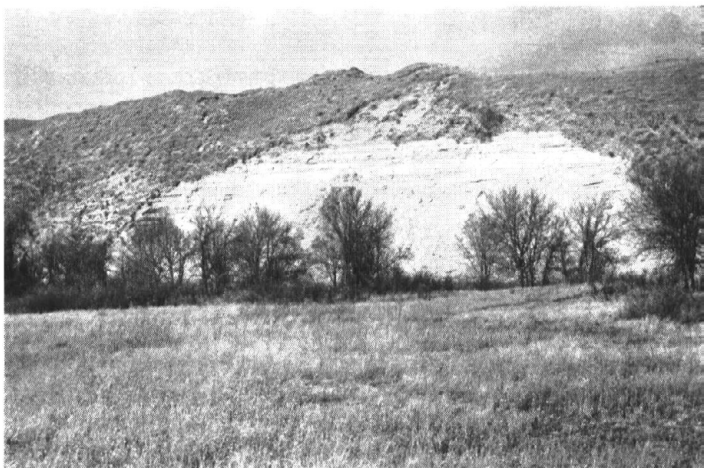

Figure 22.—**Nearly white Ogallala sandstone exposed by cutting action of the river; many feet of eolian sand overlie this sandstone.**

In this county, parent material has had more influence on soil formation than climate, vegetation, topography, or time. All of the soils have developed in the eolian sand, or locally, from sandy alluvium along flood plains and terraces. The wind has sorted out the fine particles and left mostly fine sand in the form of dunes. As a result, all the soils except those in some of the valleys, are exceptionally sandy. In some of the valleys, however, some silt has accumulated. Much of the acreage of poorly drained soils has some silt near the surface.

Topography.—The Sandhills region is characterized by small and large dunes and ridges separated by swales and valleys. Because the sandy soils readily absorb water, there is little or no runoff and no defined surface drainage in most of the county. Underdrainage is good, and most of the excess water is carried off by subsurface flow to the Middle Loup and Dismal Rivers. Along the western border of the county, there are some poorly drained valleys that have been partially drained by ditches. These drainage ditches start the Dismal River and the south branch of the Middle Loup River.

Surface drainage has a definite pattern only along the Dismal and Middle Loup Rivers. The rivers have cut down into the Tertiary materials. This has resulted in steep breaks, about half a mile wide and parallel to the rivers, where Ogallala sandstone is exposed and the land is deeply dissected by intermittent drains.

Soil development has been affected by the moisture in the imperfectly drained valleys. The soils in these valleys generally have a much darker surface soil because more organic matter has accumulated. In the poorly drained valleys, the soils show some gleying and accumulation of iron. Soils in both the imperfectly drained and poorly drained valleys usually show free lime near the surface. The areas of rough broken land have not developed much soil material, because of rapid runoff and the erosion that goes with it.

The dune type of topography, which is typical of large areas in the county, has had its effect on soil development. There has been less soil development on the dunes than in the swales and valleys between the dunes.

Living organisms.—Vegetation has been exceptionally important in soil development in this county. Without vegetation, the shifting sand would never have been stabilized.

The vegetation on the uplands consists mainly of native grasses, but also of perennial forbs and some low shrubs such as wild rose, sand cherry, and leadplant. Sedges and rushes predominate on the poorly drained soils. A few cedars and broadleaf trees grow along the rivers and on the rough broken areas adjacent to the rivers.

The soils of Hooker County are those typical of grasslands. The few trees have had little effect on soil development. Organic matter derived mostly through decay of grasses is responsible for the dark color of the surface layer of some of the soils. Soils with a good, dense cover of grass generally have a darker and thicker surface soil than those having a sparse cover of grass. The more recently stabilized soils have a more sparse vegetation and only slight soil development. Wet areas generally have the most lush growth of vegetation and the darkest surface soil.

Micro-organisms have played an important part in soil development. They help not only in improving soil tilth by breaking down organic matter into humus, but also in making available a supply of plant nutrients. When the grasses and other plants can obtain more nutrients, they produce more roots, stems, and leaves, which under natural conditions, are returned to the soils. The coarse sandy soils do not have so many micro-organisms as finer textured soils.

Worms, rodents, and other burrowing insects and animals have affected soil formation. They mix the soil, aerate it, and provide channels for penetration of water.

Climate.—This county has a microthermal, subhumid climate characterized by extreme summer and winter temperatures and deficiency of moisture in some seasons. At Mullen, the average annual precipitation is 18.89 inches, the average annual daytime temperature is 64° F., the average annual nighttime temperature is 35°, and the average number of days without killing frost is 137. Most of the rainfall comes during the growing season. Rainfall is sufficient to grow a good cover of tall grass, and has been important in stabilizing the loose sand and in soil formation. Rainfall has not been great enough to leach the soils excesssively. It has been enough to leach the well-drained soils of free lime, if lime was ever present. Most of the soils are too young to show the full influence of the climate.

Time.—The soils of this county range from old to very young. They differ not only in actual years of age, but also in apparent age. These differences in actual or apparent age are indicated by their degree of soil development. Valentine fine sand, hilly, for instance, is a young soil because only a short time has elapsed since the sand was stabilized. Valentine fine sand, rolling, the Dunday soils, and the Anselmo soils are somewhat older. The Elsmere and Gannett soils are probably still older. Loup fine sand is a young soil on very recent alluvium. Other things being equal, the older soils generally have a thicker and darker surface soil.

Classification of Soils

The soil series of Hooker County are classified by great soil groups as shown in table 11, which also shows parent material, topography, and drainage for each series. Climate and living organisms are not shown in this table because they are relatively uniform throughout the county and therefore cannot account for broad differences among the soils. Age of the soils, though not shown in the table, is to some degree indicated by their placement in the great soil groups. Soils of the Chestnut and Humic Gley great soil groups are older than those of the Regosol great soil group.

Chestnut soils

Chestnut soils have a dark-brown surface horizon that grades to lighter colored parent material. Soils of this great soil group normally have layers of accumulated calcium carbonate 1 to 4 feet below the surface. In Hooker County, however, their parent material was mostly noncalcareous, so this lime zone occurs in only a few places.

TABLE 11.—*Soil series classified by great soil group, and the parent material, topographic position, and drainage of each*

Great soil group and series	Parent material	Topographic position	Drainage
Chestnut:			
Anselmo	Eolian sands and silts.	Nearly level valleys.	Good.
Elsmere [1]	Eolian or alluvial sands.	Level valleys	Imperfect.
Humic Gley:			
Gannett	Eolian sands	Level depressions.	Poor (surface and internal).
Regosols:			
Loup	Alluvial sand and gravel.	Level flood plains.	Poor (high water table).
Dunday	Eolian or alluvial sands.	Nearly level valleys.	Good.
Valentine	Eolian sands	Hummocks and dunes.	Good to excessive.

[1] Intergrade to Humic Gley.

The Chestnut soils in this county are of the Anselmo and Elsmere series. The Elsmere are imperfectly drained soils that intergrade to the Humic Gley great soil group.

Humic Gley soils

Soils of the Humic Gley great soil group have developed in poorly drained depressions. They contain a gleyed layer characterized by neutral gray colors and presence of ferrous iron. The gleying results from intense reduction brought about by the poor drainage. The Gannett is the only soil of this group in Hooker County.

Regosols

Soils of the Regosol group show little or no horizon development. The soils of this great soil group in Hooker County are the Loup, Dunday, and Valentine. The Loup soil overlies alluvial sediment (fine sand and gravel); the Dunday soils overlie eolian or alluvial sand; and the Valentine overlies eolian sand. Along the river breaks, where Ogallala sandstone is exposed, the eolian sand of the Valentine and Dunday soils contains some material from this soft, fine-grained rock.

Climate of Hooker County

Hooker County, like most of central and western Nebraska, is in the central part of a vast area having pronounced slope to the east. In Wyoming, to the west, the Rocky Mountains are not a solid ridge, as they are to the southwest, so winds from the west blow across the mountains and sweep into Nebraska. The mountain barrier to the west does not stop the winds but is high enough to cut off most of the moisture from the Pacific Ocean. To the north, east, and south of Hooker County there are no climatic barriers; consequently, there are sharp changes in temperature. Moisture-bearing winds from the Gulf and the southern Plains States frequently move northward over this region late in spring and early in summer, and in winter wind from this direction brings warmer weather.

The climate is of the kind that favors the growth of grass. Dry weather during winter and early in spring is unfavorable to the natural spread of trees. Since the soils in this area are sandy, they blow when unprotected. The soils therefore have remained under native grass. Only about 0.5 percent of the land is under cultivated crops.

In winter, cold weather generally alternates with the warm periods. When the westerly to southwesterly winds are dominant, the weather is warm, but when winds come from northern and central Canada, the weather is cold. Snowfall is light early in winter, but increases as the season advances. During the frequent periods of warm weather, the snow usually melts, so there are few long periods of snow cover. The heaviest snowfall comes in March, but by that time the sun is high enough in the sky that the snows are soon melted. Heavy wet snows are rather common in April. They provide welcome moisture and give the grass a good start, but they are unfavorable for livestock on the range. The average snowfall for April is greater than that for December.

By May the ground is warming rapidly as the sun continues its travel northward, but the upper air is still rather cold. This cold air, combined with moisture from the south, results in showers. Precipitation, mostly in the form of showers and thunderstorms, increases to a maximum early in June (table 12). The sandy soils permit rapid absorption of these rains, so there is little surface runoff. The changeable temperatures in spring, together with rather frequent late frosts and windy days, preclude the growing of any but the hardiest varieties of fruit.

As the summer advances, the upper air warms gradually, but there is a smaller change in surface temperature than in spring. From July on, moisture-bearing winds from the Gulf also tend to move northward farther to the east. Consequently, the rainfall diminishes rather rapidly. Many summer days are hot, but the nights are generally cool. The low moisture content of the air permits rapid cooling after sundown. This, coupled with higher elevation, produces larger daily range in temperature than the range in lower regions to the east. The soils are grass covered, however, and do not get so hot as plowed soils or those under wheat stubble after harvest. Summers in this county therefore are not so hot as they are on wheatlands to the south.

Autumn is usually the most pleasant season. The land surface cools more rapidly than the upper air, so the precipitation is generally light. There is also less wind than at other seasons. There are many bright days, but the clear air permits rapid cooling at night. The first freezing temperature usually occurs during September (table 13). The dry weather cures the range grasses, which provide good pasture for some months after growth has ceased. Cattle frequently winter well on these cured range grasses until after the first of the year. Snowfall is usually so light that grazing can continue until rather late in winter.

TABLE 12.—*Temperature and precipitation in Hooker County*

[Data from U.S. Weather Bureau station at Mullen, Nebr. Average daily maximum and minimum temperatures based on a 21-year record ending in 1959; precipitation based on 36 years of complete record during period 1895–1959; snowfall based on records in the period 1927–59]

Month	Temperature		Precipitation					
	Average daily maximum	Average daily minimum	Average	Driest year (1895)	Wettest year (1944)	Percentage of months with less than half of average [1]	Greatest in 24 hours	Average snowfall
	°F.	°F.	°F.	Inches	Inches		Inches	Inches
January	36.7	11.2	0.53	0.20	2.22	33	1.73	5.9
February	40.1	13.7	.55	.55	1.44	31	1.15	7.2
March	46.9	20.5	1.10	.90	1.00	20	1.40	10.1
April	61.7	32.9	2.30	1.30	2.06	20	2.95	4.3
May	73.5	43.9	2.93	2.04	4.88	19	2.50	0.9
June	82.7	53.6	3.21	4.60	5.15	10	3.45	0
July	91.3	60.1	2.85	.34	6.23	24	3.00	0
August	89.2	58.8	2.08	.94	3.00	13	3.50	0
September	80.3	48.0	1.36	.25	.25	36	2.20	0
October	68.1	36.0	1.10	0.00	.34	28	3.00	1.2
November	50.5	23.0	.46	.41	2.40	33	1.00	2.5
December	42.4	16.9	.42	.16	.33	36	.75	3.6
Annual	63.6	34.9	18.89	11.69	29.30		[2] 3.50	35.7

[1] For example, percentage of all Januaries in the recording period that had less than half of the average precipitation for the month of January; that is, less than half of the average of 0.53 inch reported for January.

[2] Greatest 24-hour precipitation that ever fell in 1 year in the recording period of 36 years.

TABLE 13.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Mullen, Hooker County, Nebr.]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	Apr. 18	Apr. 29	May 7	May 19	May 28.
2 years in 10 later than	Apr. 12	Apr. 24	May 1	May 13	May 23.
5 years in 10 later than	Apr. 2	Apr. 14	Apr. 21	May 2	May 12.
Fall:					
1 year in 10 earlier than	Oct. 22	Oct. 16	Oct. 8	Sept. 28	Sept. 12.
2 years in 10 earlier than	Oct. 27	Oct. 21	Oct. 13	Oct. 3	Sept. 17.
5 years in 10 earlier than	Nov. 7	Oct. 31	Oct. 24	Oct. 14	Sept. 26.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is reduced.

Alluvium. Fine material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. Amount of moisture that can be held in the soil and that is available to plants. Amount of moisture held in soil between field capacity (about one-third atmosphere of tension) and the wilting coefficient (about 15 atmospheres of tension).

Calcareous soil. Soil containing enough calcium carbonate (often with magnesium carbonate) to form bubbles visible to the naked eye when treated with cold, dilute hydrochloric acid. Soil that is alkaline in reaction because of presence of free calcium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Colluvium. Soil material, rock fragments, or both, near the base of rather steep slopes. The deposits have accumulated through soil creep, slides, and local wash.

Complex, soil. A mapping unit consisting of different kinds of soils that are in such small individual areas or in such intricate patterns that they cannot be indicated separately on a map of the scale used.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms for consistence commonly used in this report are the following:

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under moderate pressure between thumb and forefinger and coheres when pressed together.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Soft.—When dry, soil mass is very weakly coherent and fragile; breaks to a powder or individual grains under very slight pressure.

Hard.—When dry, moderately resistant to pressure; barely breakable between thumb and forefinger.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Eolian (aeolian) soil material. Soil parent material accumulated through wind action; commonly refers to sandy material in dunes.

Horizon, soil. A layer of soil, approximately parallel to the soil surface, that has characteristics produced by soil-forming processes.

Mapping unit. All areas of a named kind of soil, soil complex, or miscellaneous land type shown on the soil map and identified by a symbol. In this report, the word "soil" is frequently used as equivalent to "mapping unit."

Miscellaneous land type. A mapping unit used for areas of land that have little or no natural soil; or that are too nearly inaccessible for orderly examination; or that occur where, for other reasons, it is not feasible to classify the soil.

Mottling, soil. Contrasting patches of color that vary in number and size. Descriptive terms for mottling are as follows: *Contrast*—faint, distinct, and prominent; *abundance*—few, common, and many; and *size*—fine, medium, and coarse. Mottling in a soil usually indicates poor aeration and restricted drainage.

Natural drainage. Refers to the conditions of drainage that existed during development of the soil, as opposed to altered drainage, which commonly results from artificial drainage or irrigation but may be caused by the sudden blocking or deepening of drainage outlets. Seven different classes of natural drainage are recognized:

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly intermediate in texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all of the time.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, though mottling may be absent, or nearly so, in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper part of the profile.

Parent material. The material from which the soil has formed.

Permeability, soil. The quality of the soil that enables it to transmit water and air. Terms used in this report to describe permeability are as follows: *slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. In this report, a subdivision of the soil type based on differences in the soil type that affect management but do not affect kind, thickness, and arrangement of layers in the soil profile. Actually, a phase can be a subdivision of a soil series, soil type, or other unit in the natural, or taxonomic, classification of soils.

pH value. A numerical means for designating relatively weak acidity and alkalinity, as in soils and other biologic systems. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. See pH value.

Relief. The elevation or inequalities of the land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils that have diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent of clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile. A soil series may include two or more soil types that differ from one another in texture of the surface soil.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soils of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Surface layer. The topmost layer in the soil profile, regardless of the thickness of this layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness.

Terrace, geologic. An old alluvial plain, ordinarily flat or undulating, that borders a river, lake, or sea.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm.

Texture, soil. The relative proportions of sand, silt, and clay particles in a soil mass. (See Clay, Sand, and Silt.) The basic textural classes, in order of increasing proportions of fine particles are as follows: *Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy classes may be further subdivided by specifying "coarse," "fine," or "very fine."

Topsoil. Presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Type, soil. A subdivision of the soil series made on the basis of differences in texture of the surface layer.

Water table. The highest part in the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Winnowed soil. Soil from which the wind has removed finer particles.

GUIDE TO MAPPING UNITS, RANGE SITES, AND CAPABILITY UNITS

[See table 4, p.15, for estimated yields on soils cultivated; table 5, p.20, for trees suitable for planting in windbreaks; tables 7, 8, and 9 for engineering properties of the soils; and table 10, p. 30, for approximate acreage and proportionate extent of each soil]

Map symbol	*Soil*	*Page*	*Range site*		*Capability unit*	
			Name	*Page*	*Symbol*	*Page*
Ao	Anselmo loamy fine sand, 0 to 1 percent slopes	31	Sandy	6	IIIe–5	17
B	Blown-out land	31	(1)		VIe–5	18
DA	Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes.	32	Sandy	6	IVe–5	17
DuB	Dunday loamy fine sand, 2 to 5 percent slopes	32	Sandy	6	IVe–5	17
2DuB	Dunday loamy fine sand, terrace, 2 to 5 percent slopes.	32	Sandy	6	IVe–5	17
DuB2	Dunday loamy fine sand, 2 to 5 percent slopes, eroded.	32	Sandy	6	IVe–5	17
Ea	Elsmere loamy fine sand	33	Subirrigated	6	IVw–5	17
Eb	Elsmere fine sand	33	Subirrigated	6	VIw–5	18
Gn	Gannett sandy loam	33	Wet Land	5	Vw–1	18
Ld	Loup fine sand	33	Wet Land	5	Vw–5	18
Lm	Loup loam	34	Subirrigated	6	Vw–1	18
VaC	Valentine fine sand, rolling	34	Sands	8	VIe–5	18
VaD	Valentine fine sand, hilly	34	Choppy Sands	8	VIIe–5	18
VcB2	Valentine loamy sand, hummocky, eroded	35	Sands	8	VIe–5	18
VR	Valentine soils and rough broken land	35	Thin Breaks	8	VIIs–3	18

[1] Not assigned to a range site; land now stabilized by vegetation that formerly was Blown-out land is in the Sands range site.

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA CONSERVATION
AND SURVEY DIVISION

GENERAL SOIL MAP
HOOKER COUNTY, NEBRASKA

N

SOIL ASSOCIATIONS

1 Valentine, rolling-Anselmo Association: Rolling hills and valleys

2 Valentine, hilly-Dunday Association: Choppy hills and valleys

3 Valentine, hilly, Association: Choppy hills

4 Valentine, rolling, Association: Rolling hills

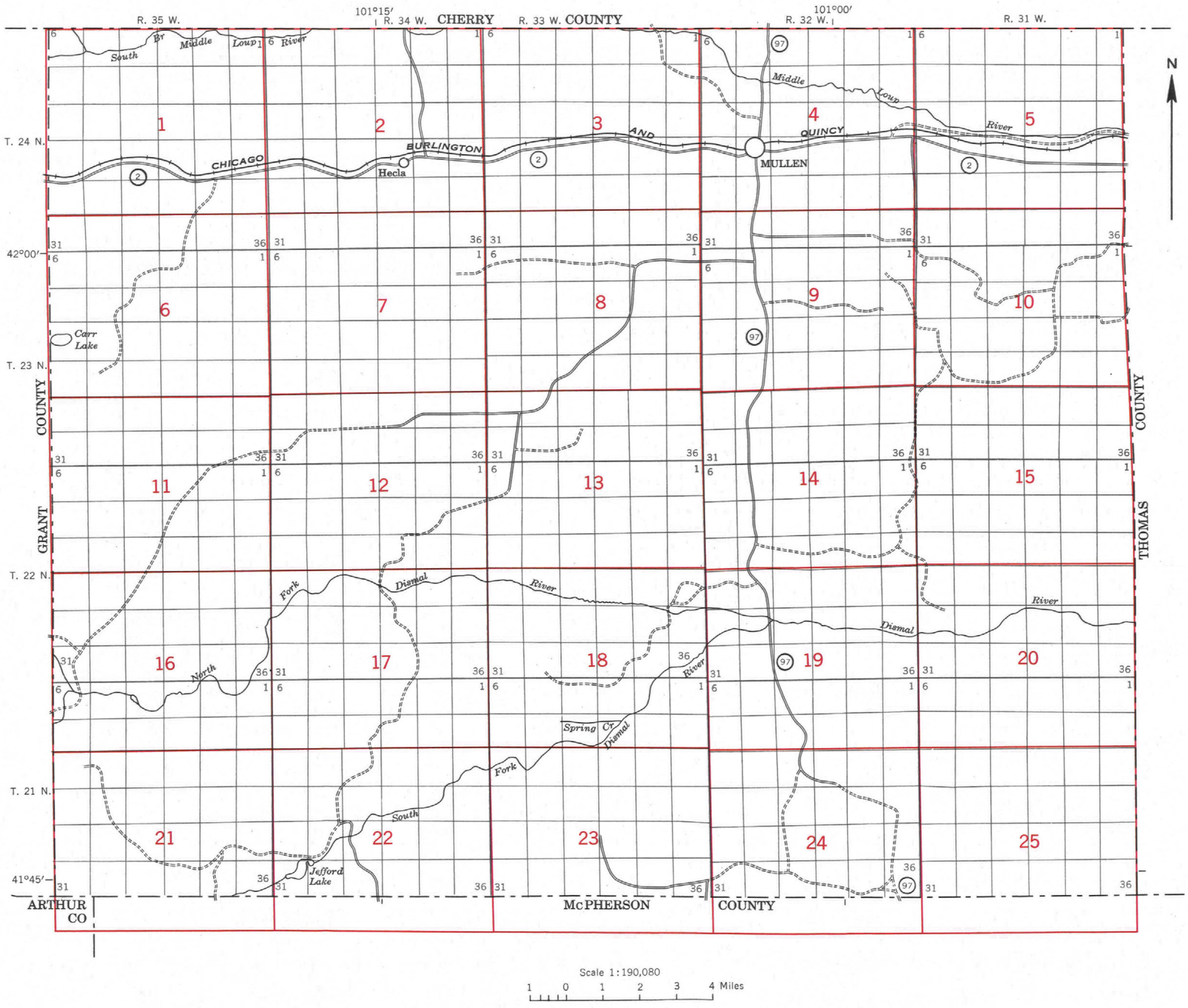
5 Elsmere-Dunday-Valentine Association: Hills and wet valleys

6 Valentine-Loup Association: River breaks and bottoms

June 1963

Scale 1:190,080
1 0 1 2 3 4 Miles

INDEX TO MAP SHEETS
HOOKER COUNTY, NEBRASKA



Scale 1:190,080

1 0 1 2 3 4 Miles

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

HOOKER COUNTY, NEBRASKA

UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

SOIL LEGEND

SYMBOL	NAME
Ao	Anselmo loamy fine sand, 0 to 1 percent slopes
B	Blown-out land
DA	Dunday-Anselmo loamy fine sand, 0 to 1 percent slopes
DuB	Dunday loamy fine sand, 2 to 5 percent slopes
2DuB	Dunday loamy fine sand, terrace, 2 to 5 percent slopes
DuB2	Dunday loamy fine sand, 2 to 5 percent slopes, eroded
Ea	Elsmere loamy fine sand
Eb	Elsmere fine sand
Gn	Gannett sandy loam
Ld	Loup fine sand
Lm	Loup loam
VaC	Valentine fine sand, rolling
VaD	Valentine fine sand, hilly
VcB2	Valentine loamy sand, hummocky, eroded
VR	Valentine soils and rough broken land

Soil map constructed 1963 by Cartographic Division, Soil Conservation Service, USDA, from 1955 aerial photographs. Controlled mosaic based on Nebraska plane coordinate system, north zone, Lambert conformal conic projection, 1927 North American datum.

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries
- Mine dump
- Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Fence
- Fence on road
- Fence on county line

Windmills

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches (CANAL / DITCH)

Lakes and ponds
- Perennial
- Intermittent

Wells (flowing)

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 1

CHERRY COUNTY

GRANT COUNTY

R. 35 W.

T. 24 N.

(Joins sheet 2)

(Joins sheet 6)

Middle Loup River

South Branch

BURLINGTON AND QUINCY

CHICAGO

N

Scale 1:31 680

0 5000 Feet

0 ½ 1 Mile

Range, township, and section corners shown on this map are indefinite.

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska Conservation and Survey Division.

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 2

R. 34 W.

CHERRY COUNTY

T. 24 N.

N

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 7)

South Branch Middle Loup R.

Ld

Middle Loup R.

Hecla

CHICAGO BURLINGTON AND QUINCY

VaC VaD DuB2 DA B VR

Scale 1:31 680

0 ½ 1 Mile

0 5 000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 3

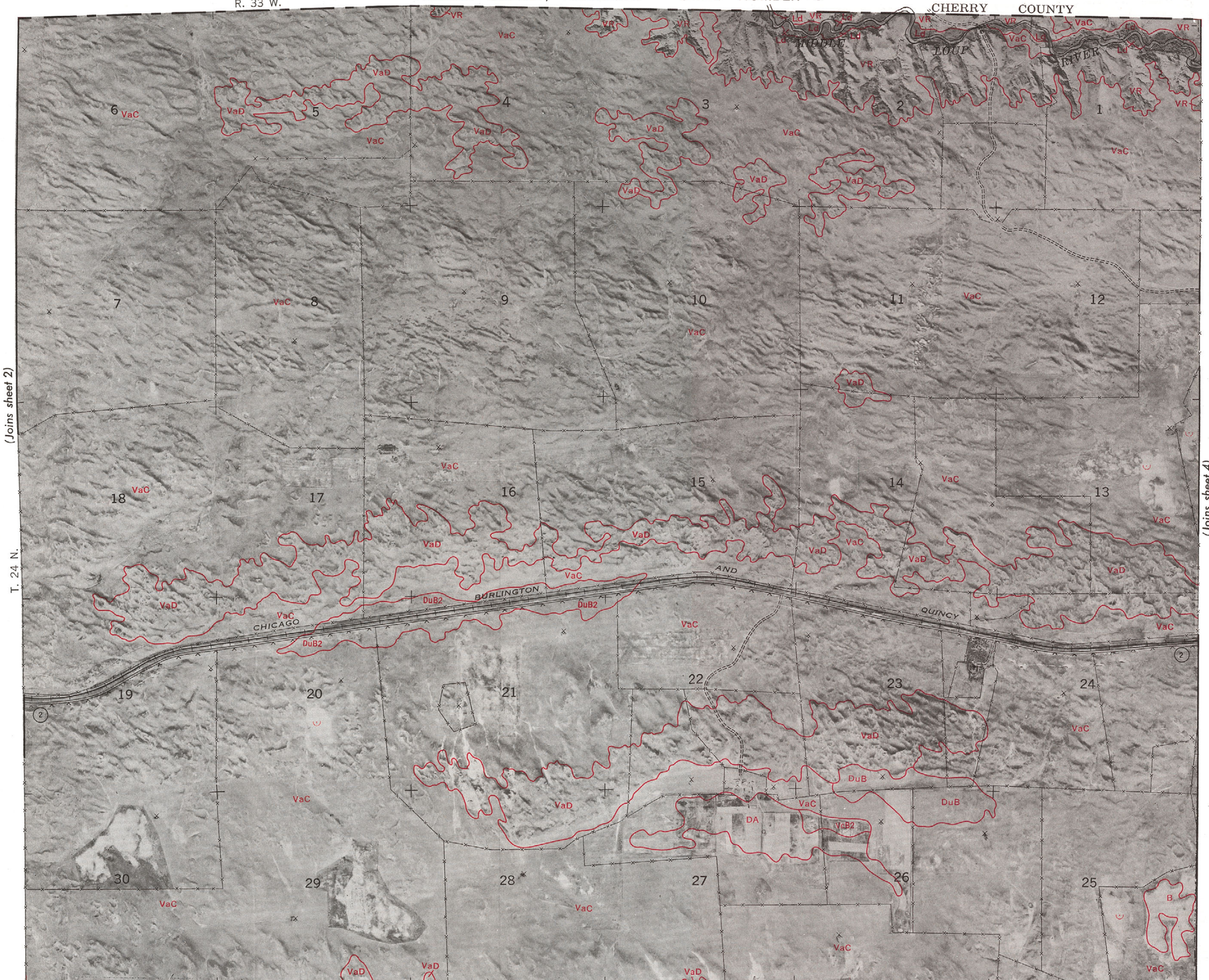
R. 33 W.

CHERRY COUNTY

MIDDLE LOUP RIVER

T. 24 N.

CHICAGO BURLINGTON AND QUINCY



(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 8)

0 ½ 1 Mile

Scale 1:31 680

0 5 000 Feet

N

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 4

CHERRY COUNTY

R. 32 W.

T. 24 N.

N

MULLEN

Corral

MIDDLE LOUP RIVER

CHICAGO, BURLINGTON AND QUINCY

(Joins sheet 5)

(Joins sheet 3)

(Joins sheet 9)

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 5

R. 31 W.

CHERRY COUNTY

THOMAS COUNTY

T. 24 N.

(Joins sheet 4)

(Joins sheet 10)

MIDDLE LOUP RIVER

CHICAGO BURLINGTON AND QUINCY

Scale 1:31 680

0 ½ 1 Mile

0 5 000 Feet

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Range, township, and section corners shown on this map are indefinite.

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 6

6

(Joins sheet 1)

R. 35 W.

N

T. 23 N. | T. 24 N.

GRANT COUNTY

Carr Lake

(Joins sheet 7)

(Joins sheet 11)

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 7

R. 34 W.

(Joins sheet 2)

7

N

T. 24 N.

T. 23 N.

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 12)

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

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HOOKER COUNTY, NEBRASKA — SHEET NUMBER 8

R. 33 W.

(Joins sheet 3)

(Joinssheet 9) | (4)

T. 23 N. | T. 24 N.

(Joins sheet 7)

(Joins sheet 13)

N

31 32 33 34 35 36

6 5 4 3 2 1

7 8 9 10 11 12

18 17 16 15 14 13

19 20 21 22 23 24

VaC VaD DuB DuB2 DA B Ao VcB2

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 9

R. 32 W.

(Joins sheet 4)

9

N

T. 24 N.

T. 23 N.

(13) (Joins sheet 8)

(Joins sheet 10)

(Joins sheet 14)

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

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HOOKER COUNTY, NEBRASKA — SHEET NUMBER 10

(10)

R. 31 W

T. 24 N.

T. 23 N.

THOMAS COUNTY

N

(Joins sheet 5)

(Joins sheet 9)

(Joins sheet 15)

VaC, VaD, DuB, DuB2, B, VcB2, DA

31 32 33 34 35 36

6 5 4 3 2 1

7 8 9 10 11 12

18 17 16 15 14 13

19 20 21 22 23 24

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 11

R. 35 W.

(Joins sheet 6)

11

N

T. 22 N. | T. 23 N.

GRANT COUNTY

(Joins sheet 12)

(Joins sheet 16)

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

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HOOKER COUNTY, NEBRASKA — SHEET NUMBER 12

12

N

(Joins sheet 7)

R. 34 W.

T. 22 N. | T. 23 N.

(Joins sheet 11)

(Joins sheet 13)

(Joins sheet 17)

Scale 1:31 680

0 ½ 1 Mile

0 5 000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 13

R. 33 W.

(Joins sheet 8)

(Joins sheet 14) | (9)

13

N

T. 22 N. | T. 23 N.

(Joins sheet 12)

(Joins sheet 18)

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

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(Joins sheet 9)

(14)

R. 32 W.

T. 22 N. | T. 23 N.

N

30 29 28 27 26 25

31 32 33 34 35 36

6 5 4 3 2 1

7 8 9 10 11 12

18 17 16 15 14 13

VaC VaD DuB DuB2 DA B

(Joins sheet 15)

(18) | (Joins sheet 13)

(Joins sheet 19)

0 ½ 1 Mile

Scale 1:31 680

0 5 000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 15

R. 31 W.

(Joins sheet 10)

15

N

T. 22 N. | T. 22 N.

(Joins sheet 14)

THOMAS COUNTY

(Joins sheet 20)

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

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16

(Joins sheet 11)

R. 35 W.

N

GRANT COUNTY

T. 21 N. | T. 22 N.

(Joins sheet 17)

(Joins sheet 21)

Rosebud Lake

Proctor Lake

North Fork Dismal River

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 17

R. 34 W.

(Joins sheet 12)

17

N

(Joins sheet 16)

(Joins sheet 18)

T. 21 N. | T. 22 N.

(Joins sheet 22)

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

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(Joins sheet 13)

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 18

R. 33 W.

(Joins sheet 19) | (14)

N

(Joins sheet 17)

T. 21 N. | T. 22 N.

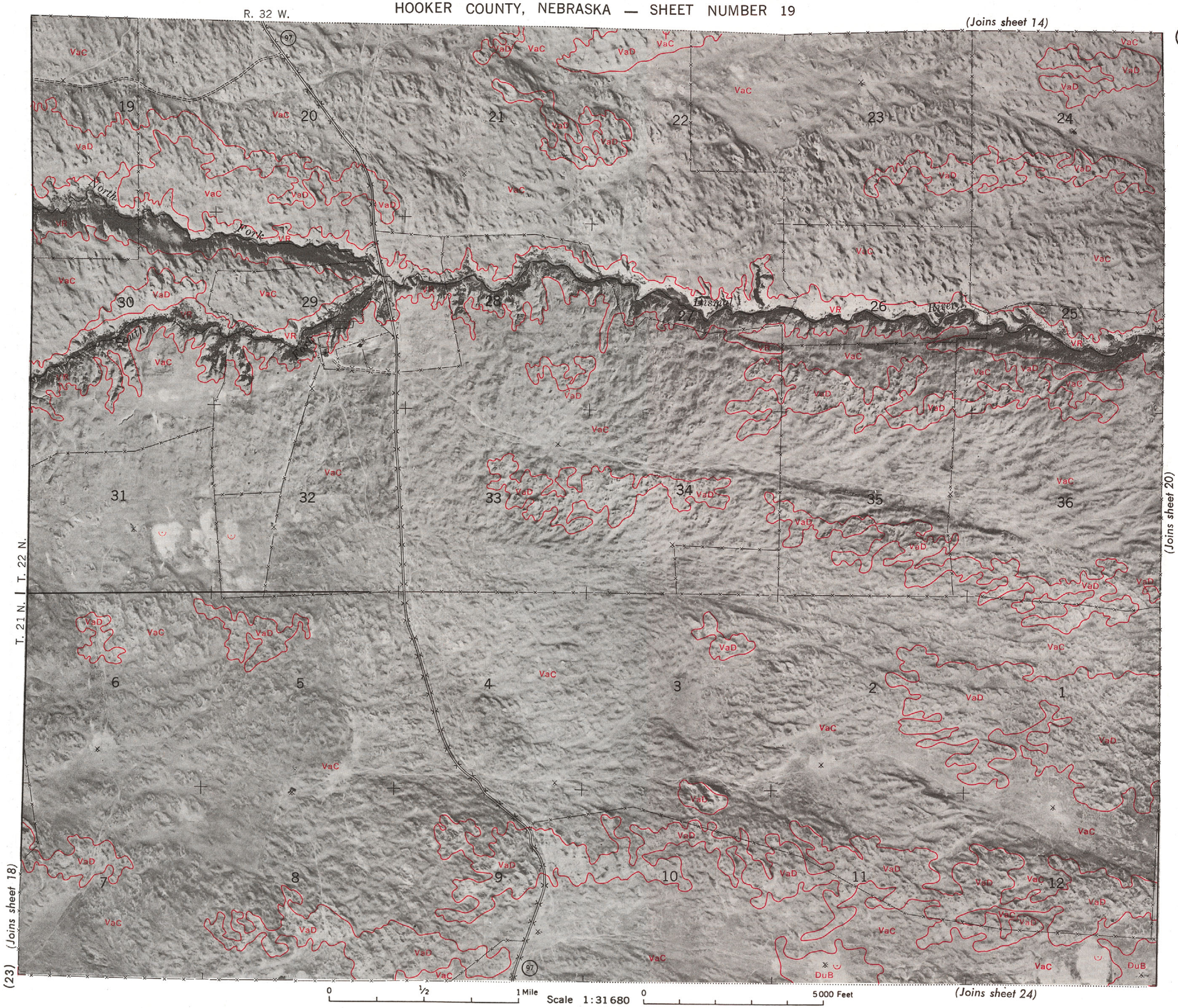
(Joins sheet 23)

Scale 1:31 680

0 ½ 1 Mile

0 5 000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 19



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HOOKER COUNTY, NEBRASKA — SHEET NUMBER 20

(20)

(Joins sheet 15)

R. 31 W.

N

19 20 21 22 23 24

30 29 28 27 26 25

31 32 33 34 35 36

6 5 4 3 2 1

7 8 9 10 11 12

DISTAL RIVER

THOMAS COUNTY

T. 21 N. | T. 22 N.

(Joins sheet 19)

(Joins sheet 25)

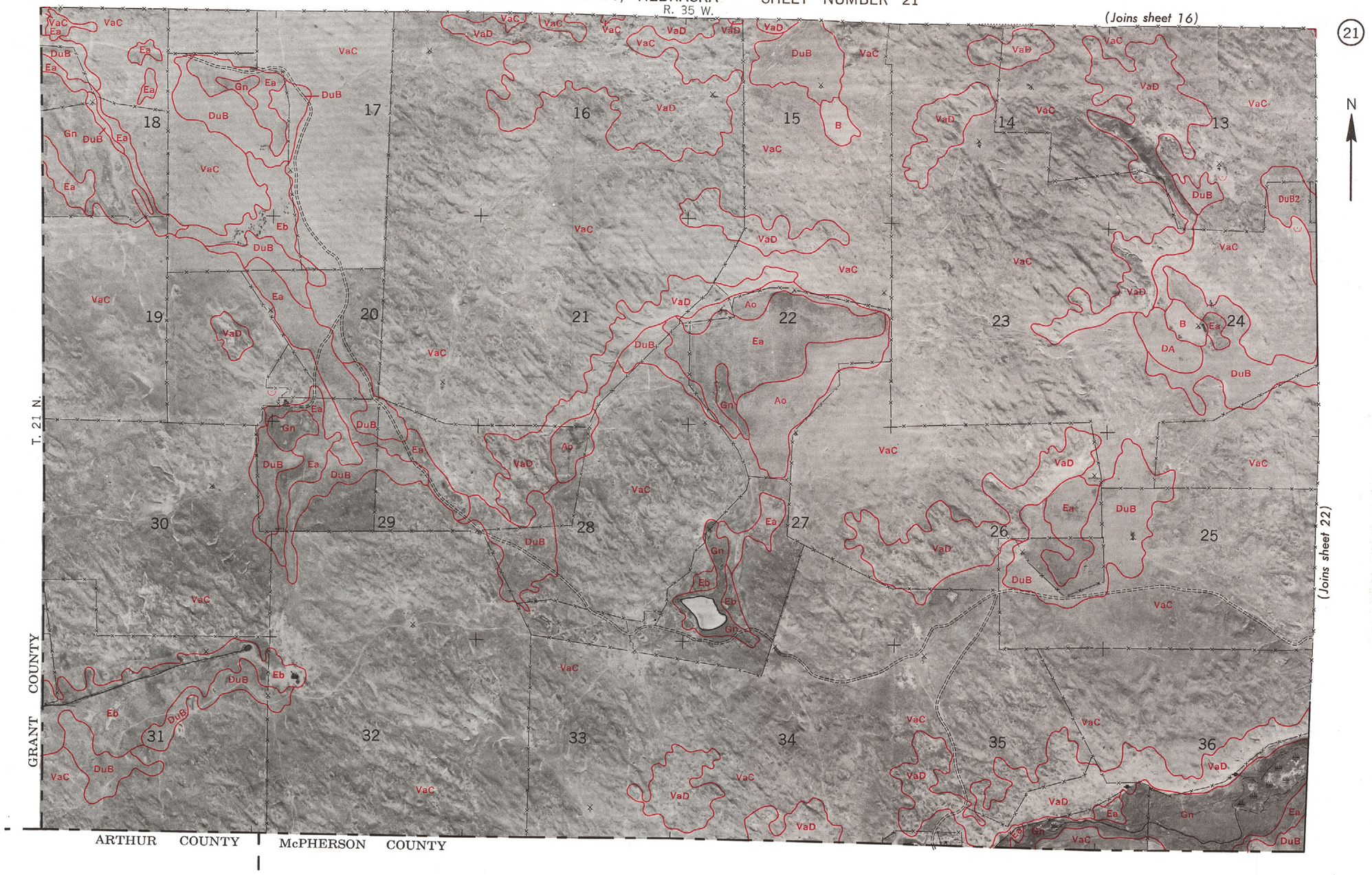
VaC VaD VR DuB B DuB2

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 21



0 ½ 1 Mile

Scale 1:31 680

0 5 000 Feet

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HOOKER COUNTY, NEBRASKA — SHEET NUMBER 22

R. 34 W.

22

(Joins sheet 17)

N

(Joins sheet 21)

(Joins sheet 23)

T. 21 N.

18 17 16 15 14 13

19 20 21 22 23 24

30 29 28 27 26 25

31 32 33 34 35 36

Dismal River

South Fork

Lake Jefford

VaC VaD DA DuB DuB2 Ea Eb Gn Lm VR B

McPHERSON COUNTY

0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 23

R. 33 W.

(Joins sheet 18)

(Joins sheet 19)

(23)

(Joins sheet 24)

N

(Joins sheet 22)

T. 21 N.

South Fork Dismal River

18 17 16 15 14 13

19 20 21 22 23 24

30 29 28 27 26 25

31 32 33 34 35 36

VaC VaD VR B DuB2 DuB DA

McPHERSON COUNTY

0 ½ 1 Mile

Scale 1:31 680

0 5 000 Feet

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HOOKER COUNTY, NEBRASKA — SHEET NUMBER 24

(24)

(Joins sheet 19)

R. 32 W.

N

T. 21 N.

(Joins sheet 23)

(Joins sheet 25)

McPHERSON COUNTY

Scale 1:31 680

0 ½ 1 Mile

0 5000 Feet

HOOKER COUNTY, NEBRASKA — SHEET NUMBER 25

R. 31 W.

(Joins sheet 20)

25

N

(Joins sheet 24)

T. 21 N.

THOMAS COUNTY

McPHERSON COUNTY

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0 ½ 1 Mile

Scale 1:31 680

0 5000 Feet